Railway Mechanical Engineer

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An Incentive to Provide for Car Maintenance

A study of the probable effects of the adoption as a permanent policy of a scale of prices for labor and material expended in the maintenance of foreign freight cars in interchange, high enough to include a profit, reveals a wide range of possibilities, the ultimate result of which will all tend toward cheaper maintenance of equipment. One of the difficulties in the way of adequate maintenance of freight car equipment under heavy traffic conditions—when a large part of the work must be done—is the lack of adequate facilities. It is true that many railroads are adequately supplied with such facilities and it is only because of this fact that other railroads can continue to operate without making provision for the full share of repairs which the volume of their traffic should bear. For such roads there is little incentive to make the improvements needed so long as to the well equipped roads may be left a considerable measure of the responsibility for taking care of the equipment of the country, when it costs the poorly equipped roads less to pay for the work at M. C. B. rates than to do it themselves. The prices fixed at the present time are high enough to show a profit for those roads whose costs are considerably below the average. But if they were fixed with the deliberate intent of including an average profit of 10 or 15 per cent above the actual cost of labor, material and overhead, would there not be created a powerful incentive for those roads whose costs are high because of a lack of adequate modern facilities, to provide the needed facilities? Is it not reasonable to suppose that, once provided, these facilities would fully justify themselves by the reduction in unit costs, the immediate benefit of which would accrue to the roads making such investments?

The Foreman a Business Man

The lack of training which foremen are given to fit them for their responsibilities as leaders of men was forcefully brought to attention by G. M. Basford's paper before the February meeting of the Western Railway Club. Leadership is probably the most important function of the foreman, but the variety of ability and capacities the possession of which are advantageous both to the foreman and to the railroads, is almost endless. There are others than that of leadership which ought to be developed by training. One of these is the ability to visualize the job of running a shop or a roundhouse as a part of the business of furnishing transportation, in which money is spent to get certain results; and the ability to see the part these results play in the production and the cost of train miles. Conditions are such at the present time that the problem of leadership is paramount and it must be solved if satisfactory relationships are to be re-established on the railroads. The very necessity for concentrating on this one problem, however, entails the danger of a loss of breadth of view leading to the neglect of other factors affecting the cost of equipment maintenance and operation. Not only is it necessary to get production from labor, but it is necessary to take advantage of every device or plan whereby the need for depending on labor may be eliminated. Sometimes these

things are beyond the authority of the foreman because of the capital investment involved. But the ability of the foreman on the ground to see the possibilities, even though his authority will not permit him to go ahead independently, is an asset the railroad should cultivate. A recommendation for many improvements of this nature must originate with the foremen and if the dollars and cents aspect—the business aspect—can be presented along with the more tangible advantages of convenience, an invaluable service has been rendered to the head of the department. Too frequently, however, when such ability shows itself among the foremen its exercise is discouraged, if not suppressed, by the executive officers of the department and until these officers not only learn to recognize its value but develop it themselves, it is unfair to expect much from the foremen.

Are Diesel Locomotives A Possibility?

Anyone reading the article regarding the Diesel engine in railroad service, which appears in this issue, cannot fail but be impressed with the prominent role this development has assumed in Sweden and with some of the claims advanced for the Diesel engine as a source of motive power in heavy traction. While the advocates of the oil engine are not laboring under any delusion as to the prospect of any immediate use of the Diesel motor in heavy traction, it is felt that as our higher grade fuel resources approach exhaustion the economic pressure upon large fuel users will be so great as to force the adoption of a more economical prime mover. It is argued that this applies with particular force to the railroads since they are the largest consumers of high grade fuels and are already feeling acutely the great increase in cost. While current fuel prices are expected to decline, no return to the prewar levels is anticipated, and there is bound to be a gradual appreciation in the price of any commodity as its supply diminishes. Sooner or later the law of supply and demand is going to work some tremendous changes in the conduct of our railroads. Just as we now realize that the railroads could not have held up under the war strain had it not been for other appliances contributing to the economy of the modern locomotive, so the day will come when some of the refinements that we are now reluctant or afraid to adopt will be regarded as equally vital. If electric traction is some day to figure prominently on railroads of dense traffic, is it altogether rash to predict the advent of the Diesel locomotive in sparsely populated districts remote from fuel producing centers? The Diesel engine underwent a remarkable development in submarine service during the war, and it is claimed that German manufacturers are now perfecting a transmission mechanism which will make it possible to use the same design Diesel motor in rail traction.

The Effect of a Seniority Ruling

The mutual welfare of railroad owners, managers, shop executives and shop employees is dependent on a just and common sense method of settling present disputed questions. It is impossible for one class to profit long at the expense of another and the best interests of all will be served by the early establishment of fair working conditions. One question about which there has been a wide diversity of opinion has been the rights of a workman due to his seniority or length of service. There can be no question but that in certain instances a seniority ruling will prevent injustice should there be partiality on the part of a foreman or should a man's ability for some reason be unknown. In by far the larger number of cases, however, experience has demonstrated that seniority does more harm than good, particularly as it prevents ambitious workmen from securing justified advancement. Moreover, the effect of this ruling is to encourage shiftlessness on the part of indifferent workmen who realize that they will be advanced according to length of service and irrespective of whether they turn out a fair day's work or not. This results in a decrease in shop production which is hard to estimate.

Another serious effect of the seniority ruling and one which should cause its abolition is the fact that a shop man may be allowed to try for a position for which he is entirely unfitted simply because he is the oldest man in length of service. A most forceful example of this occurred recently in a railroad shop where a young machinist, who had become thoroughly familiar with the operation of a piston rod grinding machine, was displaced by an older man who knew nothing about the machine. According to the National Agreement, the older man had three weeks in which to make good and for two weeks he struggled along with the machine. Production practically stopped and finally, lack of attention to lubrication caused the grinding wheel spindle bearings to melt and put the machine entirely out of commission. Men should not be tried out on work for which they are obviously unfitted and thoughtful shop workers, as well as managers, must realize that in the long run every one loses as the result of such wasteful practices.

Railroad Administration Draft Gear Tests

In this issue of the *Railway Mechanical Engineer,* there appears the first installment of a series of articles describing the tests of draft gears conducted by the Inspection and Test Section of the Railroad Administration. To those who have sought in vain for definite information among the many conflicting statements regarding draft gear performance that have been published in the past, these tests will be of incalculable value. The scope of the tests and the field of investigation remaining to be covered cannot be set forth more clearly than is done in the preface to the report by C. B. Young, under whose direction the work was conducted. In his introduction, Mr. Young states that when the Railroad Administration decided to build the standardized equipment, the Committee on Standards and the Purchasing Section were both embarrassed owing to a lack of definite and intelligent knowledge of the relative merits of the different gears as well as the relation between mechanical value and cost. Much information on the subject of draft gears was presented by the various manufacturers, but a comparison of the information offered soon developed the fact that each manufacturer had prepared his information on a basis of his own intellect, and that it was impossible to correlate or co-ordinate the various tests in any comparable manner. In the absence of definite information, the rivet shearing test was adopted, but results showed that the requirements of this specification were useless in judging the merits of the gears. The Inspection and Test Section was therefore requested to conduct a series of tests to determine the mechanical value of each make and type of friction draft gear then regularly offered for sale and these investigations are described in the report.

The information covering the tests which have been made on new gears is definite and final. To a limited degree, tests were made on gears which have seen considerable service, but the service tests and the train operation tests which the section had planned were not made because of lack of time. As Mr. Young points out, the report must be used as a whole in order to obtain accurate and definite information concerning the draft gear. The picking out and exploiting of an idea here or there which favors one or the other of the draft gears tested, is to be discouraged and those who use the report should guard themselves against errors of this kind. The report gives reliable, entirely comparable

and unbiased values for new commercial gears of the various types and the values given should supplant the widely varying figures frequently given out in the past as a result of inaccurate, unscientific or incomparable tests.

Equalization of Weights on Locomotive Wheels

Locomotives built in recent years have usually been designed to carry loads on the driving wheels that are near the limit that the rails will bear. Furthermore, the heavy reciprocating parts add to the weight of the counterbalance and make the additional force due to the dynamic augment very great. The result is that heavy motive power imposes severe stresses on the track and lately there has been much discussion as to whether the loads are now greater than the track structure can withstand. Whether this is the case or not, it is certain that nothing should be done to increase the load on any of the wheels above its normal amount. Nevertheless this often occurs through improper distribution of the weights between wheels, either equalized together or in separate equalizing systems. Sometimes it is due to improper location of fulcrum pins or to reversing equalizers; in other cases the cause is not apparent. If locomotives were not designed with a high factor of safety, improper weight distribution would cause the overloaded parts to fail. Even if immediate failure does not occur, faulty equalization often causes much trouble. Hot bearings, broken springs and similar defects may be due to this condition when the cause is not suspected. If the weight on the leading truck or the front drivers is too low, these wheels may have a tendency to climb the rail. This is a troublesome feature of some designs of passenger engines.

To remedy the faulty conditions mentioned, the erection of the equalizing system should be done with care and the parts should be made to check with the blue print before they are applied. Even when this precaution is observed, some engines may leave the shop with the weight unequally distributed and for that reason scales for ascertaining the weight carried on each wheel should form part of the equipment of every large repair shop.

Why Build Firing-Up Sheds?

The judgment of master mechanics and shop superintendents in northern sections of the country who have taken the precaution to construct firing-up sheds for the protection of workmen while putting the finishing touches on locomotives just out of shops, was vindicated by the record-breaking snowfall in the latter part of February. There are almost always small, unfinished jobs to be done on locomotives when they leave the erecting pits, and in any case the trial runs develop work which must be done. The difficulty of getting mechanics and helpers to work effectively when exposed to severe or inclement weather and the resultant locomotive delays make some form of shelter necessary. Handling the work in the main shop is certain to hamper other operations. Some form of covered firing-up shed should be constructed in sections of the country subject to severe cold weather and provided with suitable heating and lighting arrangements. A steam line for blowers and an air line for pneumatic tools should be provided. In many cases it would also be advisable to have pits, inasmuch as these will greatly facilitate final inspection and repair work. In an actual case the cost of such a shed, substantially constructed, was only $3,500. This shed was large enough for a shop turning out not more than two locomotives a day. The interest at 6 per cent on $3,500 is $210, which represents the carrying charge on this investment. It is true that such a shed would not ordinarily be used more than half of the year, but it is equally evident that the saving due to accelerated locomotive movements and labor saving in even two or three spells of bad weather would more than equal the interest on the investment.

COMMUNICATIONS

Straight vs. Coned Treads for Driving Wheels

NEW YORK.

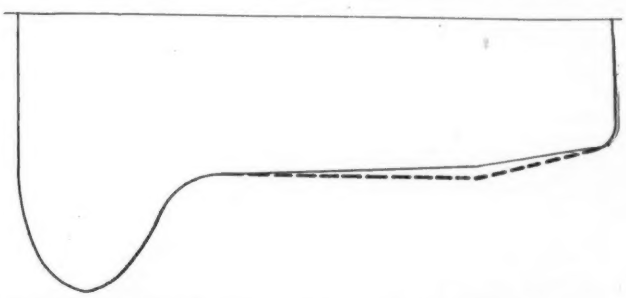
TO THE EDITOR:

The editorial relative to Sharp Tire Flanges in your issue of February, 1921, suggests the question: Why use cone-tread wheels in rigid wheel bases comprising two or more pairs of coupled wheels? The writer doubts the advisability of this practice under any circumstances other than with a single pair of wheels on a radial axle and is convinced that it is largely responsible for sharp flanges and poor tracking qualities.

Assume, for illustration, a locomotive with five pairs of coupled wheels and a rigid wheel base of 22 ft., with no provision for lateral movement other than 1/4 in. narrow tire setting on front and back wheels and the usual 1/4 in. total lateral play between wheel hubs and boxes, under which condition the maximum possible variation of alignment of flanges, is 1/4 in. between front and main, and main and back wheels. This is common practice on locomotives of the 2-10-2 type designed to traverse curves of 16 deg. deflection and a radius of 359 ft.

The middle ordinate of this curve on a 22 ft. chord is 2.02 in. and the quarter ordinates 1.51 in. Assuming the frames to be rigid the track must be laid 1.77 in. wider than standard gage to allow this locomotive to pass.

It may be seen that with the flanges of the front and back wheels in contact with the outer rail of this curve, those of



Present Standard Tire Contour and Form Proposed for Driving Wheels

the intermediate wheels will be 1.51 in. away from the outer rail and that of the main wheel will be 1.77 in. away from the outer rail.

The taper of the tread of the American Railway Association standard tire section is 1 in 20, and the diameter changes 1/10 in. for each inch of tread. Thus it may be seen that the diameter of the intermediate wheels which run upon the outer rail are .151 in. (nearly 5/32) less than those of their mates which run upon the inner or shorter rail, while the diameter of the main wheel which runs upon the outer rail is .177 in., (over 11/64) less than that of its mate, which runs upon the inner or shorter rail. This condition of the smaller of pairs of wheels running upon the outer or longer rail is undoubtedly incorrect and just how much the lateral thrust of the front and back flanges is increased by the tendency of the intermediates to run toward the outer rail, over the pressure which would be had with wheels having straight treads, is very hard to estimate in view of varying conditions of rails, the use of sand, etc. It must be considerable, however, and no doubt causes more rapid flange wear than would be had with the straight treads.

It would seem that the use of tires with straight or parallel treads as shown in dotted lines on the accompanying dia-

gram, on all wheels, would result beneficially. A good compromise would be to use A.R.A. treads on the front and back wheels and straight treads on all intermediates, although there are good and valid objections to this, as will be shown.

With cone-tread wheels on the wide gage track of sharp curves good flange lubrication is imperative and if cone treads must be used, it would appear that decided advantages would accrue from the use of some device which would allow lateral displacement of all but the main wheels, without sacrifice of stability. This applies not only to locomotives of the 2-10-2 type, but as well to any having coupled wheels.

Such a device should have only sufficient lateral resistance to permit the wheels to adjust themselves to any curve, which generally speaking, will be sufficient to return the wheels to the normal position on straight track and maintain stability in that position.

It is a well known fact that cone-tread wheels, when leaving the wide gage track of curves will seek to adjust themselves to correct diameters for straight track. In doing this several sidewise oscillations take place until the wheels find the true position. These oscillations have been known to spread the rails of poorly spiked and braced track, thereby causing derailments.

With coupled wheels of different diameters in the same wheel base on curves, some of the wheels must be slipped into correct relationship by the side rods. This no doubt causes rapid wear of rod bushings. With straight treads all diameters are alike and the only slipping necessary would be that due to the length of the rails traversed; this would produce only torsional stresses in the axles, which would not be detrimental to the rods.

While it is admitted that the cone tread is correct with one pair of wheels, it is herein suggested that straight treads have decided advantages in rigid wheel bases with coupled wheels.

CHAS F. PRESCOTT.

Ball Bearings for Railway Cars

NEW YORK, N. Y.

TO THE EDITOR:

In the article on the use of ball bearings for railway cars, published on page 23 of the issue for January, 1921, there appeared a misleading statement, which I should like to have an opportunity to correct. The ball bearings on the Swedish State Railways, which were stated to have covered 240,000 kilometers and more, were repaired several times so that it was not really the same bearing which covered the total distance. This is best borne out by the fact that the Swedish State Railways have not made any further installations of ball bearings on passenger cars, but, on the other hand, have practically abandoned their use in this service. The maker of these ball bearings has made a request to be permitted to substitute roller bearings for his ball bearings.

As for the N. K. A. disk bearings, these have since been installed in additional express train equipment on the Swedish State Railways and are now being installed on "Stockholm, Wästeras, Bergslagens Järnvägar," Sweden, in express train service in France, and on the Danish State Railways. Disk bearings are also being applied in street car service in Copenhagen and Odense Sparvägar, Denmark, and are now in operation in Malmö, Sweden.

E. F. MAAS.

(The statement regarding the service obtained from ball bearings was taken from a Consular report, which we had no method of verifying at the time. Apparently the report was misleading in this particular and we are glad of the opportunity to correct any erroneous impression that the article may have given rise to.) EDITOR.

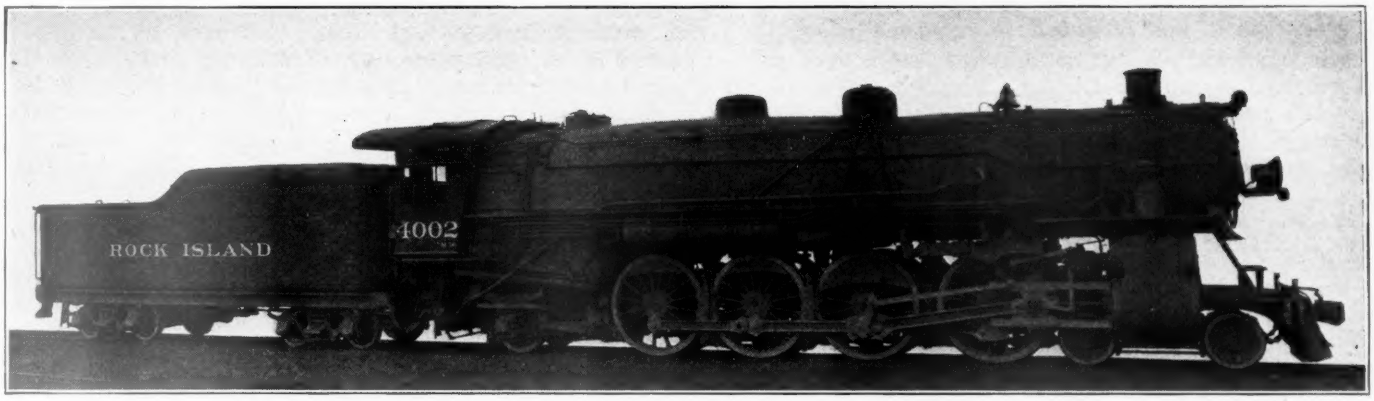
NEW BOOKS

Developing Executive Ability. By Enoch Burton Gowin, 9 in. by 6 in., illustrated, bound in cloth. Published by The Ronald Press Company, 20 Vesey street, New York city.

While this book is designed primarily for the young executive, without particular reference to his attachment to railroad service, still there can be no question but that the subject is one which should be of keen interest to a very large number of railroad men. It is certainly the greatest personal and individual problem for every young man engaged in railroad service, as well as a problem of the greatest importance to many who have graduated into important executive officers with our railroads. Railroad officers are sometimes criticized on the ground that they do not handle their work with the same degree of precision and system practiced by executives in other business activities. The author, who is assistant professor of commerce, New York University School of Commerce, Accounts and Finance, has endeavored to show how the day's work may be so systematized that it can be cleared away with ease and precision, how the executive may utilize the time thus gained for constructive effort and for the development of mental vision, initiative and reasoning power, and show him how to develop and prepare himself for broader activities and greater responsibilities. The alert and ambitious railroad man, no matter what his relative position may be, will welcome any possible suggestions by means of which he can effect many economies of time, energy and money. The book is in no sense theoretical. It is simply a common sense analysis of those qualities which characterize executive ability and the means by which this ability may be obtained. It is more than interesting to note that in illustrating his point Professor Gowin has often referred to Harriman, Hill and Ripley, and it may be doubted whether the tremendous influence of the old school railroad executives on our modern business organization is even now fully appreciated. This is not only the kind of a book railroad men should read, but it is the kind of a book that they will want to read.

Powdered Coal as a Fuel. By C. F. Herington, 303 pages, 8 in. by 9 in., bound in cloth. Published by D. Van Nostrand Company, 8 Warren street, New York city.

This is the second edition of a book which made its appearance about two years ago, and represents both a revision and enlargement upon the original text, although at the time of its publication this book probably represented the best and most complete treatise upon this subject. Since that time it cannot be denied that powdered coal has assumed a wider field of usefulness and is now regarded as a most promising development. This applies particularly to industrial operation, as it has been demonstrated that the limitations imposed upon the locomotive in its present form make the successful application of this fuel to locomotive use decidedly problematical. However, it should be of particular interest to railroad engineers to know that one of the most successful installations of powdered coal under stationary boilers has been accomplished by the Missouri, Kansas & Texas Railroad at its Parsons, Kansas, shops. It should also be stated in this connection that the American Locomotive Company has met with considerable success in the use of powdered coal in its metallurgical furnaces at Schenectady. Both of these installations and other installations of similar character in industrial plants are described in detail. The author relies more upon descriptions of successful installations than upon theoretical analysis of the subject to demonstrate the possibilities of powdered coal. The book shows very completely just what is being done at the present time with powdered coal and may serve to convince many as to what can be accomplished with this fuel.



Mountain Type Features New Rock Island Power

Greater Steaming Capacity and Larger Driving Wheels Indicate Trend in Development of This Type

UPON return to private management, the Chicago, Rock Island & Pacific was one of the earliest to place large locomotive orders. These orders included 10 Mountain, 10 Mikado and 15 Santa Fe type locomotives all of which were purchased from the American Locomotive Company and constructed at their Dunkirk plant. None of these types is new to the Rock Island since this road has operated both Mikado and Santa Fe type locomotives of the same general design in freight service for several years and was one of the first railroads to adopt Mountain type locomotives for heavy passenger service.

The selection of these locomotives by a railroad that has had experience with each type is in itself significant and would indicate that the Mikado has made a place for itself which the advent of heavier power cannot usurp. It also serves to demonstrate that the Santa Fe type is here to stay and verifies the foresight of those who placed the Mountain type in passenger service on the Rock Island seven years ago.

When the first Mountain type locomotives were placed in service on the Chicago, Rock Island & Pacific, they enabled the consolidation of the St. Louis and the Chicago sections of the Colorado trains into one train west of Phillipsburg, Kansas, where maximum and ruling grades of 1.0 per cent are encountered. The trains hauled by these locomotives usually consisted of 10 or 11 all-steel cars weighing from 675 to 750 tons although as high as 1,175 tons in 19 cars have been handled successfully over a division of 140 miles.

Pioneer and New Mountain Types Compared

The policy of the Chicago, Rock Island & Pacific with respect to the design and equipment of new locomotives has been consistently directed toward obtaining maximum efficiency in operation and economy in maintenance. Therefore, a comparison between the pioneer and the new Mountain type locomotives affords an interesting commentary upon the development of this type practically since its initiation in passenger service.

It will be observed from the specifications which are submitted in connection with this article that the rated tractive effort of both locomotives is nearly identical, but that the weight of the new locomotives is considerably greater than that of the original Mountain type. The new locomotives weigh 29,000 lb. more on the drivers and are proportionately heavier throughout.

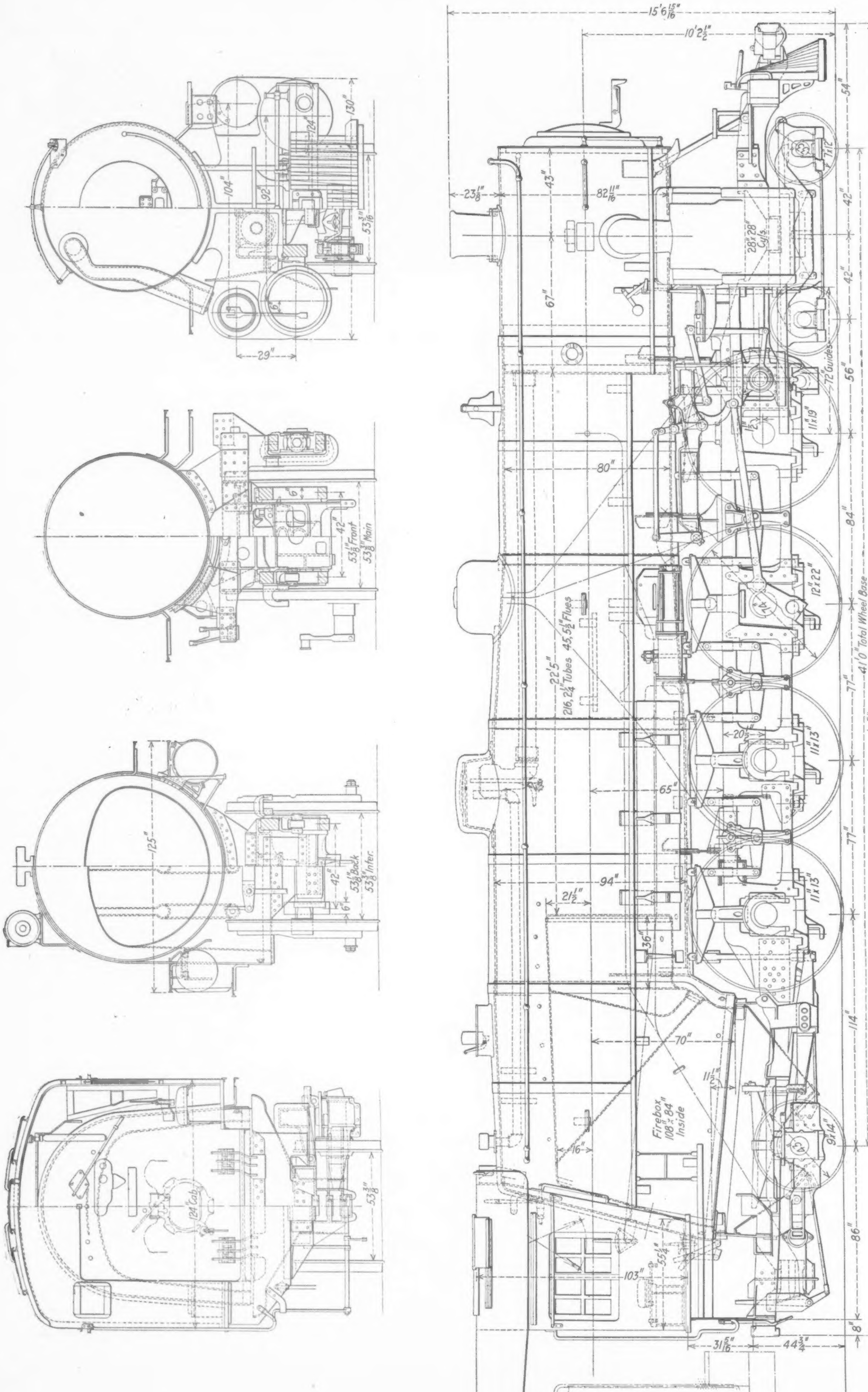
This increased weight is largely accounted for in the boiler dimensions as the total heating surface of the new locomotives, excluding the superheater, is nearly 600 sq. ft. greater. The greatest proportional increase occurs in the firebox heating surface of the new locomotives which is over 30 per cent greater than the firebox heating surface of the older locomotives. This increase is largely accounted for by the application of three thermic syphons to each locomotive as the other firebox dimensions, including the grate area, are practically the same.

The most striking difference in design, however, appears in the driving wheel dimensions, the new locomotives having 74 in. driving wheels as compared with the 69 in. wheels of the earlier locomotives. As the cylinder dimensions of the two locomotives are the same, it will be seen that the larger driving wheels tend to balance the larger boiler, which carries 200 lb. pressure as compared with 185 lb. on the original locomotives. These are the first Mountain type locomotives built with driving wheels as large as 74 in. and their ability to sustain high speeds with heavy trains will be watched with interest.

Special Features of the New Locomotives

Among the novel characteristics applying generally to all three classes of the new locomotives is the short slope of the cab front which permits all of the wrapper sheet staybolts to be outside of the cab so as to facilitate inspection and removal. All the piping is arranged so as to interfere as little as possible with inspection and minor repairs to staybolts. The location of cab appurtenances was given special attention in the design of these locomotives from the standpoint of both safety and accessibility. An outside steam turret is provided with extension handles to the valves so that all pipes having boiler pressure are located outside of the cab. The injectors also are located outside of the cab. The detached water column is specified in accordance with the recommendations of the mechanical standards committee of the Railroad Administration.

The tenders of these locomotives are of the Franklin type with unit draw-bar attachments and Commonwealth cast steel underframes. This is in distinction to the Vanderbilt type of tender which was constructed for the first Mountain type locomotives and has characterized the Rock Island locomotives for many years. It should be noted in this connection that the new tenders for the Mountain type locomotives have a water capacity of 10,000 gal. and carry 16 tons of coal in comparison to the tenders attached to the original Mountain type locomotives which had a maximum capacity of 8,500 gal. of water and 14 tons of coal. The locomotive tender has a low center of gravity with rounded bottom and corners

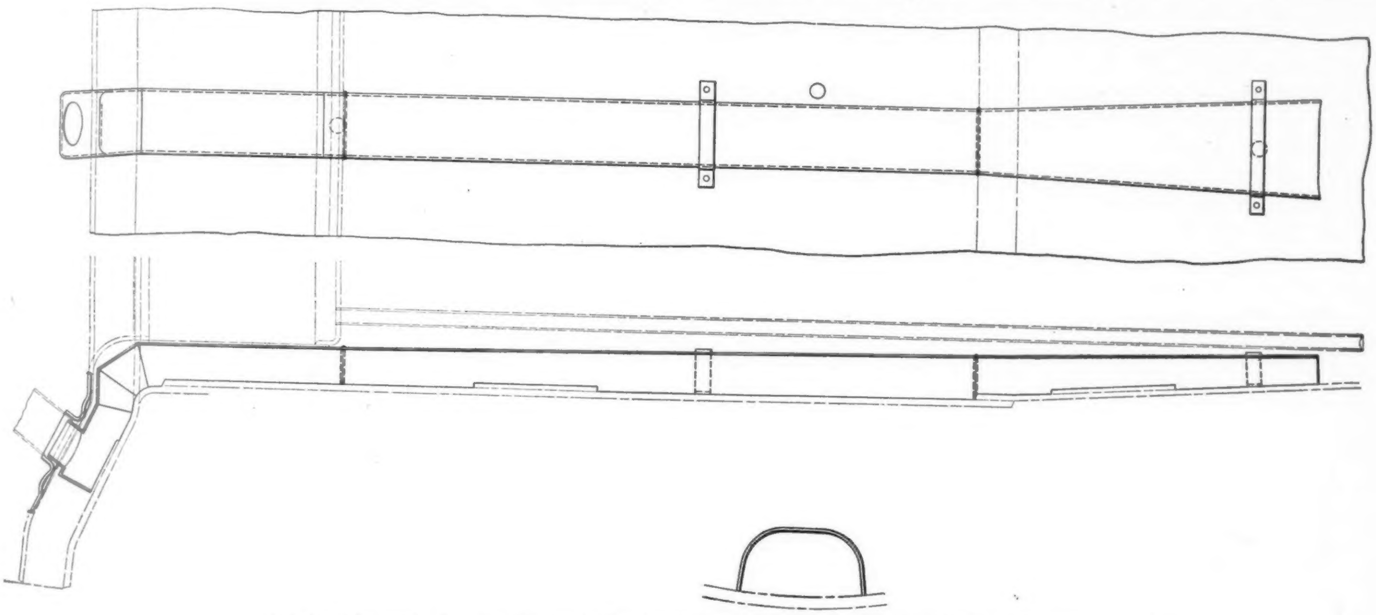


Elevation on Sectional Views of New Mountain Type Locomotives for Chicago, Rock Island and Pacific

bringing the side and bottom sheet connection above the radius so as to eliminate the customary angle in the corners of the cistern to which the side and bottom sheet are attached and which usually give trouble on account of leakage.

We are indebted to W. J. Tollerton, general mechanical superintendent, for the following statement relating broadly to the principles governing the design of these locomotives:

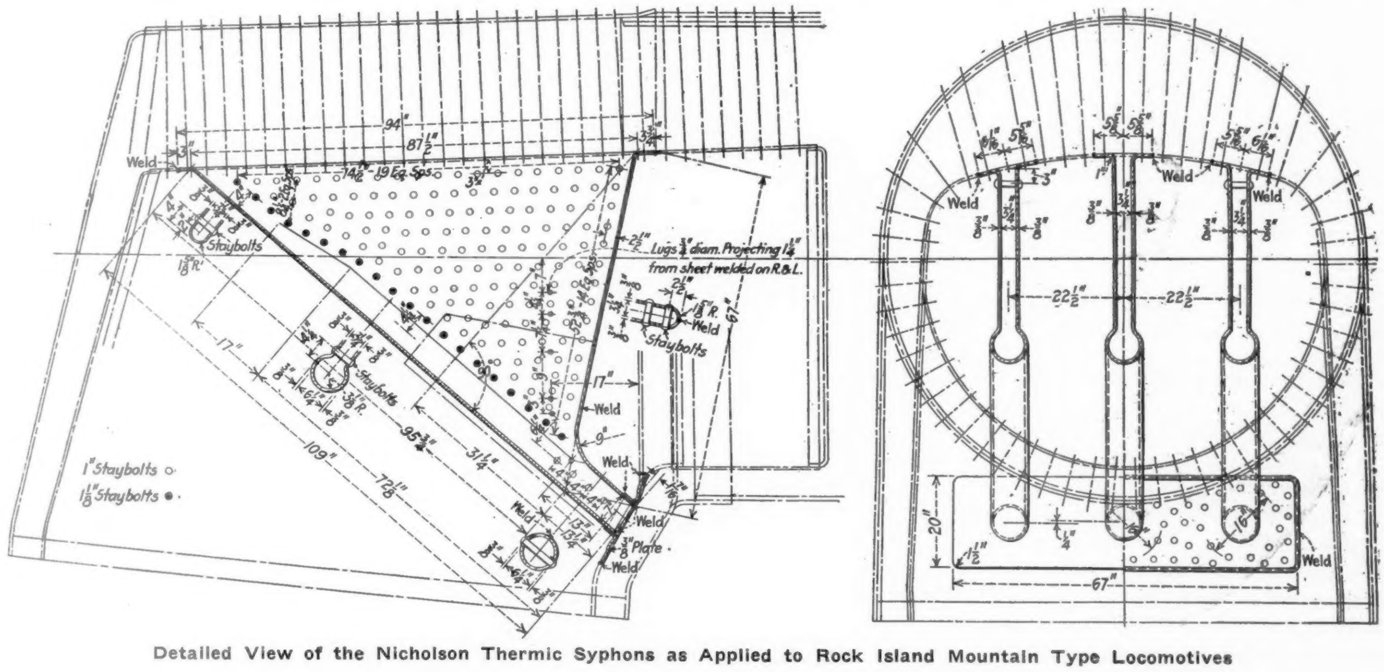
"Many of the features on these locomotives were brought about by closely watching previous engines of similar design, and the idea has been to eliminate any weakness that may have developed; also the design is prepared with a view to the greatest possible reduction of possible future shop labor when the engine is overhauled, by easy accessibility of the different parts, and the idea of making each part, if possible, run from shopping to shopping without renewal. It must be appreciated now, more than ever, that anything that can possibly be done to increase mileage and get a quicker turn on the engine, both at the terminal and when passing through shop, should be anticipated at the time the design is made."



Intake Channels for the Thermic Syphons Applied to New Rock Island Locomotives

Special Equipment Applied to the New Locomotives

The most noteworthy addition to these new locomotives in the form of a specialty designed to increase economy and capacity is the Nicholson thermic syphon, the details of which are illustrated in connection with this article. While this device has been applied to locomotives on the Rock Island for over a year and is now giving satisfactory service on a number of other railroads, this is the first instance in which the syphons have been specified throughout on new orders of Mountain, Mikado and Santa Fe type locomotives. As will be observed from the specifications and drawings, the syphons add 141 sq. ft. of heating surface to the firebox and serve to support a brick arch in place of arch tubes. The purpose of the syphons is to increase the capacity of the locomotive by increasing the firebox heating surface as noted and to improve the circulation within the boiler resulting in a freer steaming and more economical locomotive.



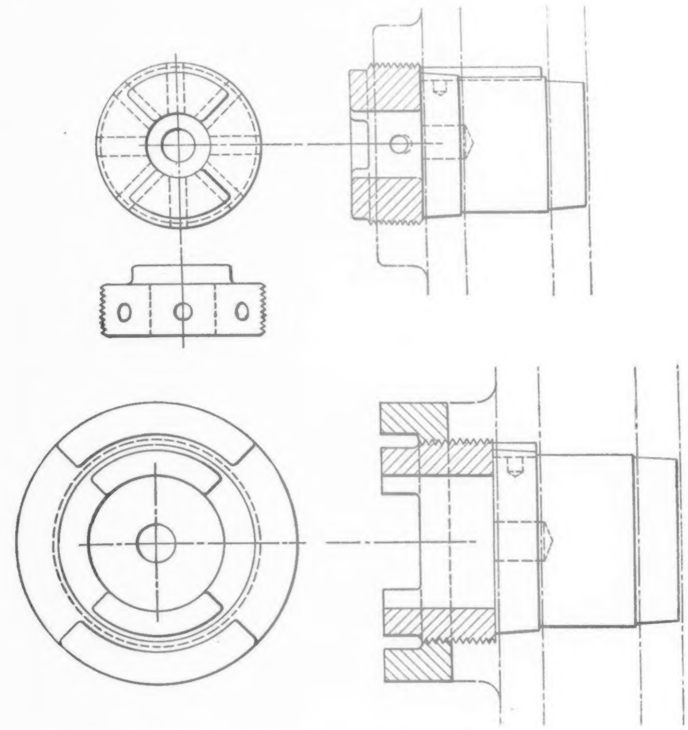
Detailed View of the Nicholson Thermic Syphons as Applied to Rock Island Mountain Type Locomotives

Two other novel and interesting specialties applied to these locomotives are the wrist and knuckle pins, both of

which are illustrated in detail. These designs are patented by the U. S. Metallic Packing Company and have the advantage of enabling the pins to be removed from the outside and the rods taken down irrespective of their position.

The new locomotives are all equipped with force feed lubricators, Barco flexible steam heat and air brake connections, Alco power reverse gears, Baker valve gear, the Woodward engine truck, oscillating front driving box, Franklin adjustable driving box shoes and wedges, hollow main crank pins with internal grease lubrication and adjustable hub plates by means of which the lateral can be taken up without dropping the wheels.

The locomotive smoke-box is equipped with the Unit spark arrester which is cylindrical in form and can be readily removed through the front door. Franklin grate shakers are applied to all of the locomotives but stokers of the Duplex type are applied only to the Santa Fe type locomotives as it has been found entirely practical to meet the maximum service requirements on Mountain and Mikado type locomotives by means of hand firing and it was thought that the application of syphons would further improve the free steaming



Removable Knuckle Pins Applied to New Rock Island Locomotives

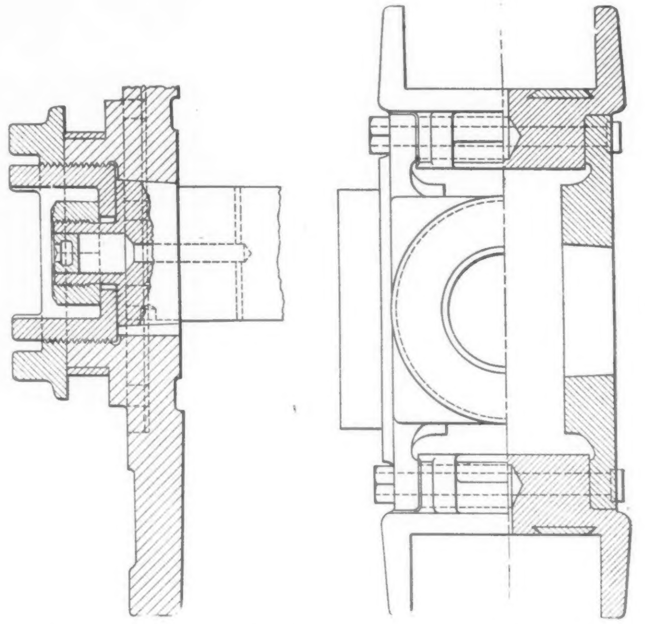
qualities of these locomotives. However, the Mountain type locomotives are designed so that stokers may subsequently be applied if found necessary.

In addition to the Alco standard drifting valve these locomotives are equipped with an auxiliary saturated steam line to the cylinder. A manually operated quick opening 1¼ in. starting valve is connected to a 1¼ in. pipe extending from the turret to the front end of the boiler. From this point, 1 in. branch pipes lead into each steam pipe. A copper pipe, having its own connection from the hydrostatic lubricator in the cab, is led to this steam line. A 1¼ in. tee is also inserted near the cab for emergency oiling of the piston valves by the engineman in case the force feed oil pump fails en route.

Mountain Type Locomotive Dimensions

The Mikado locomotives purchased by the Rock Island last year do not differ materially in design from locomotives of the same type which have been in service on the railroad for some years and the new Santa Fe type locomotives are substantially the same in design as the locomotives of this type built for this railroad in 1918 and described in the January, 1919, issue of the *Railway Mechanical Engineer*, page 41.

For convenience the principal dimensions of the Mountain



Sectional Views of Crosshead, Showing Novel Wrist Pin Design

type locomotives which were constructed for the Rock Island in 1913 and referred to in the foregoing are tabulated together with the dimensions of the new locomotives as follows:

	Chicago, Rock Island and Pacific Mountain Type Locomotives	
General Data:	Built in 1913	Built in 1920
Tractive effort	50,000 lb.	50,400 lb.
Cylinders, diameter and stroke	28 in. by 28 in.	28 in. by 28 in.
Weight in working order	333,100 lb.	369,000 lb.
Weight on drivers	224,100 lb.	253,000 lb.
Weight on leading truck	57,500 lb.	57,000 lb.
Weight on trailing truck	51,500 lb.	59,000 lb.
Weight of engine and tender in working order	490,500 lb.	559,000 lb.
Wheel base, driving	18 ft. 0 in.	19 ft. 10 in.
Wheel base, total	38 ft. 11 in.	41 ft. 0 in.
Wheel base, engine and tender	70 ft. 2¼ in.	79 ft., ¾ in.
Ratios:		
Weight on drivers ÷ tractive effort	4.48	5.02
Total heating surface ÷ grate area	6.66	7.32
Total heating surface ÷ grate area	65.4	74.4
Per cent firebox heating surface to evaporative surface	7.50	8.66
Per cent superheating surface to evaporative surface	22.9	26.6
Total evaporative surface ÷ volume of cylinders	206	234
Grate area ÷ volume of cylinders	3.14	3.15
Wheels:		
Driving, diameter over tires	69 in.	74 in.
Driving thickness of tires	3½ in.	4 in.
Driving journals, main, diameter and length	11 in. by 22 in.	12 in. by 22 in.
Driving journals, others, diameter and length	11 in. by 13 in.	11 in. by 13 in.
Engine truck wheels, diameter	34 in.	33 in.
Engine truck journals, diameter and length	7 in. by 12 in.	7 in. by 12 in.
Trailing truck wheels, diameter	42 in.	43 in
Trailing truck journals, diameter and length	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Style.	Conical	Conical
Working pressure, pounds per sq. in.	185 lb.	200 lb.
Outside diameter, first ring	78 in.	80 in.
Firebox, length and width	107½ in. by 84 in.	108 in. by 84 in.
Tubes, number and outside diameter	207—2¾ in.	216—2½ in.
Flues, number and outside diameter	36—5½ in.	45—5¼ in.
Tubes and flues, length	22 ft.	22 ft. 5 in.
Heating surface, tubes and flues	3,805 sq. ft.	4,283 sq. ft.
Heating surface, firebox	312 sq. ft.	406 sq. ft.
Heating surface, total	4,117 sq. ft.	4,689 sq. ft.
Superheating surface	944 sq. ft.	1,247 sq. ft
Grate area	62.7 sq. ft.	63 sq. ft.
Tender:		
Tank.	Cylindrical	Rectangular
Water capacity	8,500 gal.	10,000 gal.
Coal capacity	14 tons	16 tons

Getting Better Results From Railroad Organizations*

The Subordinate Officer Occupies a Strategic Position, but Is Not Properly Trained to Fill It

BY GEORGE M. BASFORD

DISCUSSIONS on reducing cost of transportation do not really begin before someone mentions the real key to the situation, which is effort of the individual all along the line to improve his production, to save. The next thing mentioned is the foreman and supervision. The foreman today is the most vital influence on the road.

Giving my conclusion first I am going to suggest what seems to me to be an absolutely unquestionable necessity on railroads today. I am going to suggest a foreman for a new job. The job is to take charge of the whole railroad organization as an organization, as a general foreman of personnel, but the man would have a title and standing that places him next to the chief executive of the road. This officer would supply a missing link in our troubled days. The chief executive was formerly so close to the small organization that he could know every man. Not only did he know every man, but he handed to them, by contact, his ideals, his desires and his inspiration. As organizations grew this link was lost. It must be found again. At this precise point in the development of railroads, and in the present complication of their problems there is nothing to be done that will net as much as securing the co-operation of the rank and file for increased production and the reduction of cost of transportation. The minute the men in the ranks, on the track, in the shops, yards, terminals, trains and engines center their minds to the fact that the best thing they can do for themselves, for the railroads, and for the public, is to get busy to save dollars, the railroads will be saved.

It is not enough that some should be striving or that some departments should be organized for effective effort of the individual. It is necessary that the effort should be general, bringing departments into combined efforts. Now we hear men say, "I should worry, the coal is not charged to my department." To answer this there must be some way for these men to learn the policy of the road with respect to coal, and the policy with respect to everything they use.

It Takes a Shock to Wake Us Up!

Is it radical, is it revolutionary to suggest a high officer for the exclusive administration of the organization as an organization, who will himself be a part of the policy of the company and whose duties are to see that everybody from himself down to unskilled labor understands that policy? Sometimes it takes a shock to wake us up. Right now we are having one. Until organization questions receive some sort of consistent attention we shall continue in trouble and in trouble that has a remedy.

How can anyone defend such a thing as this? An important department of one of our fine big railroads has not once in 30 years been presided over by an officer who grew up on that road and in that department, but in this time many importations have been made. All have been able officers but they came from "outside." Think this over!

Another big road recently had a narrow escape. A vacancy in a high position was about to be filled by an outsider when the president's attention was called to a man already in the service, who for years had been preparing for exactly that position. He was promoted. He has made good. Some say, "We need new blood." The answer is you already have it. Circulate it. Every time a stranger is imported to a high position notice is served on the entire organization that it is useless for the individual to exert himself. This is just what has happened on many of our railroads. When foremen and men see this why should the men desire to be foremen and why should foremen wish to go higher?

"Give me a bunch of good foremen and the yard will run itself," says the ship builder.

A Picture

Two years ago a large industrial organization started such a plan. It involves 15,000 men in a number of plants and includes a very large office and sales force in this country and abroad. A remarkable man was selected to manage personnel, training and promotion. He reports to the board of directors and works with the executive assistant to the president. Policies are established by conferences in which the personnel officer has a part. He carries these policies out through and with the organization, everybody knowing that he represents the highest authority. He has begun with recruiting, training and promotion questions, is developing co-operation such as is seldom seen and has made remarkable headway in better understanding among not only the different plants of the company but among the officers and men of individual plants.

To succeed the policies must be definite and the objects of the organization must be known. This officer is supplying through the organization itself that which was lost when great growth came. He is bridging the distance that was rapidly increasing between the executives and the men. He has established apprentice schools, workmen's schools and foremen's schools, which means that the foremen are studying men and methods of dealing with them and are becoming managers of men. The work he is doing is entirely applicable to the railroad, the small road as well as the large one. The railroad needs the facts he is collecting. Who have we got in our employ? What is he doing? What is he capable of doing when trained to do it? The roads need the job analysis he is making for his company and the system he is working out to find and fit men to the jobs.

Chief Clerk

Let us think a moment how chief clerks are selected. It is a personal matter with the officer. Chief clerks sign the officer's name, take action for him in his absence. I have seen over one hundred officers of a certain road in conference for several days at headquarters here in Chicago—while the chief clerks ran the road. Because this is personal service these men are selected with personal care and from men who have been through long periods of training. Naturally they make good. We should therefore think of two things in this case.

First, these men are often good material for promotion. Think of this—the chief clerk is close to his superior. He absorbs from his superior the things that made that superior successful. He grows by his contact with a bigger man. This is training, of the sort that we are talking about. Moreover, the chief clerk is in an exposed position where good work shows up quickly and clearly. Let us get the obscure men up into a brighter light and see what happens.

Second, every man on the road must and does act for the

*From an address before the February meeting of the Western Railway Club.

boss in his absence and should be selected with equal care and should be trained as well. Every man signs the name of the boss on every job he does and the railroad is about 150 ft. to 200 ft. wide and perhaps 2,000 miles long. The boss is necessarily away most of the time from most of his subordinates.

Biggest Job on the Road

Someone has said that "the foreman is the top sergeant of industry." Nothing is more true or more important in any industry than this. The character of an organization is up to the character, ability and progressiveness of the foreman. No matter who or what the captain is, the company is practically useless unless the top sergeant is right. If the foreman is a timeserver, as sometimes he has been taught to be, the men will be timeservers also and the result is well known. Who on a railroad ever gets shop foremen or yard foremen together to tell them how important their jobs are and to show them that to their men they represent the railroad? Are they encouraged to know the manhood, ability and possibilities of their men? Does the foreman look with his own eyes alone or does he look with the eyes of the management? Does he know his men when off the job? Is he their friend and advisor?

How is a new foreman selected when a foreman leaves? He may be most skilled with his hands and may be most proficient with his own work, but he must know how to manage and operate the most complicated, most delicate machine in the world—a human organization with intricate problems always present. Is he usually told about the management of men and is he helped and supported as he should be in that management?

Some big successful industries are getting to a point of appreciating what foremen can do and are already holding foremen's schools and foremen's meetings to bring these important men to see their own possibilities. Remarkable results are being obtained by leading the foremen to realize that they are really administrators of human affairs, that they require wisdom as well as ability, that an army is what its commander makes it, that the gang reflects the leader and that the leader must know and have the confidence of the men he leads.

In the question of shop foremen a new situation developed instantly when piecework was abolished. Is it not true that piecework furnished the incentive to the individual worker, whereas incentive in earlier days had been supplied by the foremen? Under piecework the foremen deteriorated, in some cases to the mere checking of work. Foremanship received a knockout when, by piecework, men received more than the foremen did. When piecework disappeared this left many roads with foremen who were not trained at all and did not know how to furnish the incentive to the men. This is not the fault of the foremen, but of the system of things which changed. It confirms the opinion that the loss of inspirational contact has been serious.

The Traveling Engineer

Is it possible that these vitally important men can get closer to the men on the engines and represent to them the ideals and the humanity of the wonderful organization of a railroad? There is no finer body of men than those who run our engines, but as a body what do they know, what do they see of the management? It is represented to them by rules, the breaking of which means trouble. These men can affect the treasurer's figures more than any other class of men on the road. For instance, they can improve ton-mile figures more than anyone else can. I believe that a 10 per cent saving in fuel lies in the hands of these men whenever the desire to save it is made an ideal with them and when the idea of saving is "sold" to them.

Roundhouse Foreman

Here is the man who must be the manager of his men. He is often isolated and must rely on himself and frequently faces great difficulties of weather, lack of facilities, even of conveniences, and without sufficient subordinate supervision in his work. His work is a continuous emergency. A big roundhouse job is as big as the head of the department had a generation ago.

The new officer we are talking about would give the roundhouse foreman great encouragement, would help him get the facilities he needs inside and outside of the roundhouse. This officer would be able in a short time to provide him with trained men. Here is a good place for a start to be made in reducing idle time of engines. Here is where industrial intelligence counts heavily. Co-operation counts most of all. Despatchers should understand the roundhouse. Traveling engineers should spend enough time there to understand how engines come in off the road.

Recruiting Officers

Without a systematic method for taking recruits into employment, without insisting that employing officers should work to a certain plan or system the character of recruiting will depend largely upon and will be limited by the ability, the personality and methods of those who do the hiring. Various manufacturing plants employ highly trained recruiting officers in employment offices. Some concerns go so far as to employ psychological tests, others use intelligence tests, means for selecting recruits having become a science. We may hold different opinions as to the tests suggested and used, but it seems decidedly necessary that greater care in some form should be exercised, especially in recruiting for permanence. Those who have made exhaustive study of employment officers and recruiting officers in industries say that there is no case on record of this work having been abandoned when once started.

Employment management in industry has become a profession, devoting itself to getting and keeping men through uniform, consistent policies.

Recruiting Along the Road

Let us select for various jobs young men and boys who are recommended because of character, physical ability and the necessary intellect. One way to select them is to enlist the aid of local officials along the line of road. Station and local officials of all departments may be asked to recommend those they know about or whose parents they know. The headmaster of the grade school or the principal of the high school, the clergy, and even the local judge may and will recommend the best material when they are interested to do so. Having in mind office boys, apprentices and young men it stands to reason that living along the line of the road they will already have an interest and an embryo undeveloped loyalty to the property from which the loyalty so greatly needed under present conditions may have promise of development. Wherever this is done the results have justified the plan and it seems worthy of consideration.

Labor Turnover

To engage new men, teach them their duties and launch them into service costs a lot of money. To engage, train and then lose them in large numbers is a very serious loss. It is one of the biggest leaks in industry. To hire and lose a skilled man costs from $250 to $300 in one industry which has been studied. It must cost railroads more than that because in many cases great damage is done by such men. I know of one large railroad shop which for three years in fairly busy times had not found it necessary to go beyond its own apprentice graduates to supply all the skilled talent needed and in that period no skilled workman was hired from outside.

Inspiration

A large majority of men take pleasure in accomplishment of a good piece of work. Making something, repairing something or making a good run over the road brings satisfaction and is in itself an inspiration. Praise is often in order but must be used with discretion, so also censure. Notice taken in either case indicates that the company cares whether work is done well or not and most men will respond.

A road had three shops far apart and a flue job at each. One of the flue gangs had made a record. The leaders of the gangs at the other shops were sent to investigate. They went back and beat the record. This was not all. All three flue jobs were overhauled, new machinery installed and a lot of money saved. Mere expression of interest inspired these men to do good work and they were happier for doing it. It is a part of training of men to show them that the job they are doing is of great importance to the road.

Friends

Everybody needs a friend. Every young man finds a turning point in his career, a point in his life when he wakes up to a realization of his responsibility and his opportunity. It may be that a word of advice, of caution, of recommendation given at the right time will make, and the absence of it will break a career. It is most fortunate if this friend is his employer or the representative of his employer, the foreman, the general foreman, the master mechanic, the train master, the chief despatcher. In older days when organizations were small it was the boss himself. In these days of big things it is the representative of the boss. The most important thing a big organization can do is to provide the thing that bigness has outgrown—personal contact with big unselfish minds, minds big enough to give a point of view to an individual. The employer is really the best friend of the employee. If this is not true in any case it must be made true. Then it must be understood by every officer and every workman. How shall this be done? It must be somebody's business to get it done.

Good Soldiers

Nobody ever wanted "good soldiers" as railroads want them now. Railroad men are good soldiers, but who are their leaders and why? Most men are followers, in fact everyone is a follower of some sort. We worship heroes and ideals. We follow leaders more able, capable or perhaps more dominant than ourselves. Shall we follow our superior? That depends upon their leadership and we are "company men" or "organization men" depending on the influences and their strength.

What is to be done about it when others lead our people away? Is there nothing we can do? Let us remember that the "old man" used to be the leader, and let us consider the possibility of regaining some of his leadership in the days that are to come. It will be needed. Men always have followed and always will follow those whom they think "get" them most. It is important to find a way to discover, recognize and reward individual ability.

Discussion

Talking things over brings co-operation. When people get together for discussion responsibility is necessarily forced upon those present and the natural tendency is to look at the question from the other man's point of view. This is the value of meetings, especially when the object is to reveal and develop the importance of the person who has a tendency to consider himself obscure and overlooked. Nothing in any organization helps so much as for this man and that man to stand up and tell in his own way what or who is holding him back. When the accused must answer the chances are that more complete understanding will be reached. The chief who is present is not the only one who will begin a liberal education from discussions with his foremen or his men.

Apprenticeship

I use the word apprenticeship with hesitation simply because to most people it suggests merely "trades." It really represents training, thorough training of the hands, of the mind and of the morals of the lad. What we need today is a modern up-to-date substitute which will fit the times and the change from an employer with one employee to the multiple employer with thousands of employees. The principles involved remain the same. Let me quote from a report of a Massachusetts Commission on industrial training:

"In many industries the processes of manufacture and construction are made more difficult and more expensive by a lack of skilled workmen. This lack is not chiefly a want of manual dexterity, though such a want is common, but a want of what may be called industrial intelligence. By that is meant mental power to see beyond the tasks which occupy the bench for the moment, to the operations which have preceded and to those which follow it—power to take in the whole process, knowledge of materials, ideas of cost, ideas of organization, business sense and a conscience which recognizes obligation."

Consider what the sort of training this suggests would mean in saving money for the railroads, applicable as it is to every department, every office, the track, the yard, the terminal, the roundhouse and of course the shop. Apprenticeship of this kind should not, by any means, be limited to the shops. Some roads, notably the Santa Fe, have faithfully developed apprenticeship and have enjoyed wonderful results. This road should be proud of the 1,506 graduates of its apprenticeship courses. What has been done with shop trades should now be extended to every department, every office and every job.

Selling an Idea

Experience in selling something to people who think they do not want it would help the leaders of big organizations more than they know. An organization must have ideals. To succeed these must be sold to those who are to carry out the principles—to the official staff and by them they must be sold to the rank and file. Is the ideal of reduced cost of transportation sold to the men in the ranks? Do many of the men say, "What do I care? There is more coal, more material, and more time where this came from." When the ideal that the roads are working for is sold to the men the present labor problem will be simplified. Foremen and subordinate officials can and I believe will accomplish this in the future, but selling necessarily involves something to sell—which in this case is not lacking—and ability to bring the purchaser's mind to the need to buy.

Looking Ahead

How are we to look ahead when we have so many troubles in hand? Troubles we shall always have and if years ago we had looked into the future on the personnel question our difficulties today would be less. If we do so now they will be less ten years from now.

In the development of railroads a lot has happened since the day when a road was so small that the superintendent was the only operating officer—when the master mechanic and everybody else, having to do with operation, reported to the superintendent. The old "Czar" system has gone. In that system the "Old Man" held everyone's job in the palm of his hand, hired and fired as he liked, rewarded and punished as the old-time head of the family rewarded and punished his children and there was no one to question him. In those days the captain of a ship held little more power than the railroad official.

There was something fine about the old method when the highest operating officer knew everybody. In spite of the faults of the system, which really was the best system for the time, it has left us some of the best traditions and has given

transportation service some of the best of men. It gave co-operation. Co-operation had to be because there was someone on hand to enforce it. This effect of co-operation has probably done more than any other one thing to tie railroad men together and make so many of the old-time railroaders feel that any man in railroad service was, in a large sense, a member of his own family. This feeling is not as strong today, co-operation is not as common, but it is, and will remain, a factor that we cannot do without. It must be provided.

Another feature of old-time railroading was the training of men. I refer not only to apprenticeship, but to the careful training of every new man for his job. As a matter of course boys entering the shops were apprentices, so also were firemen, brakemen and switchmen and all the rest. In those days somebody had time to instruct new men. Whatever else we say of those days, certain features of the times indicate a thoroughness which we do not get today. In days of old, promotion was controlled by prejudice, by favoritism, sometimes by family ties, but with all the faults of the early days, men were seldom imported from other roads.

No one wants the old days back, but it is fitting to consider features of the old which should be provided with the new. Some of these are the careful selection and training of new recruits, the spirit of the railroad men of older days, co-operation and the intimate knowledge of the men in the ranks on the part of someone in authority. Of all the things we need to take out of the past and apply to the future, the things we need the most are the selection, the training and the knowledge of men. Railroads are too big, even departments are too big to permit the operating officers to know who are working for them, but some substitute for these features of old times must be found. A way must be found for foremen at least, or sub-foremen, thoroughly to know the men working for them, their personalities, their capacities, their abilities and their qualifications for promotion. This and the selection and training of men may be supplied under present conditions and may yet make railroad service as happy as it ever was, but to accomplish this requires a lot of thought, a lot of time and a definite plan which will enlist the co-operation of the men. It calls for a high officer whose job it is to see it done.

When specially trained men were wanted in 1918, C. R. Dooley and staff delivered 100,000 trained men to the army in six months and had 40,000 more nearly ready when the armistice was signed. About 70,000 of them went across, men trained in 67 different trades. These men were selected as well as trained. Nothing that lies before the railroads is as difficult as that. The report which outlines the problem, the plan, the organization and the execution will open the eyes of any man who does not know about modern training methods.

When railroads start in to tackle their production problem in as thorough a fashion and with as complete a plan, cost of transportation will come down. Nothing will influence the workers as a real plan will do it. When they understand the plan, its objects and the country's need of it the workers will want to do their part and without their earnest efforts in co-operation success is out of the question.

There is no other way. An enlightened mind is the greatest asset on earth.

Our high official in charge of personnel cannot be expected to change the atmosphere of the organization quickly. He will not himself attempt to make the change. He will not himself attempt personally to train everybody. He will see that everybody on the road is trained, that every officer trains his own successor. He will see to it that men are specified and treated as carefully as steel and iron are. He will use the entire organization and will inspire everyone in it by concentrated effort to bring out the best in every individual in the direction of enlightened team work.

Reducing the Fuel Consumption of Power Plants

BY WILLIAM N. ALLMAN

(Continued from the February Issue)

When it is considered that only about 57 per cent to 67 per cent of the coal that is consumed in the average plant is utilized for producing steam, it becomes clear that it is also quite an important matter to retain the heat in the steam and not allow it to escape through lack of proper insulation.

Heat is much more evasive than gas, it escapes through a boiler plate or pipe about like water through a sieve. When it is considered that steam carrying a pressure of only 100 lb. per sq. in. has a temperature of about 338 deg. F. and that on the hottest summer day 90 deg. to 100 deg. F. would be extremely hot, it will be readily observed that there is a tremendous waste due to leakage if proper insulation is not provided for.

The real object of insulation is to prevent the flow of heat frcm the container to the outside atmosphere. It has often been noted that great care is exercised in guarding against losses in electrical distribution and water leakage and also against undue loss in steam pressure between the source of power and the prime movers, and not until quite recently has there been the great care given to insulation that now manifests itself. The losses in heat units through poor insulation have now become a vital factor in power plant operation, and power plant engineers and managers are very busily engaged in determining where the losses may be reduced by insulation.

Inspection of Table No. 1 will readily convey the enormous

TABLE 1—TOTAL HEAT LOSS IN B. T. U.'S PER HOUR PER LINEAL FOOT OF BARE PIPE OF DIFFERENT SIZES AND AT VARIOUS TEMPERATURE DIFFERENCES AS GIVEN BELOW

HEAT LOSS IN B. T. U. PER LINEAL FT. PER HOUR

(For finding losses at temperatures between those shown, the B. T. U. Differences per Degree are given in Column between the Main Columns or Degree Columns)

Pipe size, in.	Area of pipe surface per lin. ft.	Temperature differences 50°		100°		150°		200°		250°		300°		350°		400°		450°		500°
½	.220	21.5	.52	47.3	.64	79.2	.76	117.3	.90	162.3	1.06	215.2	1.28	279.1	1.52	355.1	1.93	451.4	2.37	569.8
¾	.274	26.8	.64	59.0	.79	98.6	.96	146.8	1.11	202.1	1.33	268.5	1.58	347.6	1.89	442.2	2.40	562.2	2.95	709.7
1	.344	33.6	.81	74.0	1.00	123.8	1.19	183.4	1.41	253.7	1.67	337.4	1.98	436.5	2.37	555.2	3.03	705.4	3.69	891.
1¼	.435	42.5	1.01	93.6	1.26	156.6	1.51	231.9	1.78	320.8	2.09	425.4	2.53	551.9	3.00	702.1	3.80	892.6	4.68	1126.7
1½	.498	48.7	1.17	107.2	1.44	179.3	1.72	265.4	2.04	367.3	2.39	487.	2.90	631.8	3.44	803.8	4.36	1021.9	5.36	1289.8
2	.622	60.9	1.46	133.9	1.80	223.9	2.15	331.5	2.54	458.7	2.99	608.3	3.62	789.2	4.29	1003.9	5.45	1276.3	6.69	1611.
2½	.751	73.4	1.76	161.6	2.18	270.4	2.60	400.3	3.07	553.9	3.61	734.5	4.37	952.8	5.19	1212.1	6.58	1541.1	8.08	1945.1
3	.917	89.6	2.15	197.3	2.66	330.1	3.17	488.8	3.75	676.3	4.41	896.8	5.33	1163.4	6.33	1480.	8.03	1881.7	9.87	2375.
3½	1.047	102.3	2.46	225.3	3.03	376.9	3.62	558.1	4.28	772.2	5.04	1024.	6.09	1328.4	7.23	1689.9	9.17	2148.4	11.3	2711.7
4	1.178	115.1	2.77	253.5	3.41	424.2	4.07	627.9	4.82	868.8	5.67	1152.1	6.85	1494.6	8.13	1901.3	10.3	2417.3	12.7	3051.
4½	1.308	127.9	3.07	281.5	3.79	470.9	4.53	697.2	5.35	964.7	6.29	1279.2	7.61	1659.5	9.03	2111.1	11.5	2684.	14.1	3387.7
5	1.455	142.2	3.42	313.1	4.21	523.8	5.03	775.5	5.95	1073.	7.00	1423.	8.46	1846.	10.0	2348.4	12.7	2985.7	15.7	3768.5
6	1.733	169.4	4.05	371.9	5.04	623.9	6.00	923.7	7.09	1278.1	8.34	1694.9	10.1	2198.7	12.0	2797.1	15.2	3556.2	18.6	4488.5
8	2.257	220.6	5.30	485.7	6.54	812.5	7.81	1203.	9.23	1664.5	10.8	2207.3	13.1	2863.6	15.6	3642.8	19.8	4631.4	24.3	5845.6
10	2.817	275.4	6.62	606.2	8.16	1014.1	9.75	1501.5	11.5	2077.5	13.6	2755.	16.4	3574.1	19.5	4546.6	24.7	5780.5	30.3	7296.
The following losses apply to flat as well as curved or cylindrical surfaces:																				
B. t. u. Lost per sq. ft. per hour		97.5	2.35	215.2	2.90	360.0	3.46	533.0	4.10	737.8	4.80	978.0	5.83	1269.4	6.89	1614.0	8.73	2050.6	10.8	2590.0

loss in B. t. u.s from uninsulated or bare surfaces and it is a surprising fact that this condition has been allowed to exist so generally. It has been estimated that the loss of heat from a bare or poorly insulated surface represents a loss in fuel ranging from 25 per cent to 65 per cent and principally for the reason that the escaping heat is not visible this can hardly be realized. If on the other hand it were visible, it would be so perceptible that steps would very quickly be taken to correct this evil and prevent the loss.

The efficiency of an insulating material is expressed by the percentage of heat saved by using the insulation as compared to what would be lost if no insulation were used and the surface left bare or uninsulated.

The efficiency of all insulation varies according to the size of pipe to which it is applied and according to the difference in temperature between the steam in the pipe and the air surrounding the pipe, as well as according to the thickness of insulation. Therefore the rate of flow of heat through a certain thickness of material and at a certain difference in temperature, determines the conductivity of the material. The relative efficiencies of insulating materials are obtained by comparing their conductivities under similar conditions. Heat is also frequently wasted where sections of insulation are not properly joined or where fittings are exposed.

Table No. 2 shows what losses may be expected from uninsulated surface. The figures are conservative, as both the boiler efficiency and the heat value of the coal are high and a lesser boiler efficiency or inferior grade of coal would cause even a greater waste in pounds of coal.

TABLE 2—HEAT LOSSES FROM UNINSULATED HOT SURFACES

ORDINARY STEAM TEMPERATURES

Temperature of Surrounding Air 70 Deg. F.

Steam pressure (gage)	Steam temperature (deg. F.)	Difference between temperature of steam and surrounding air (deg. F.)	Loss per sq. ft. per hour (B. t. u.)	Waste of coal in lb. per sq. ft. per year	Number of sq. ft. of surface that wastes a ton of coal in 1 year
0	212	142	334	293	6.82
10	240	170	425	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820	718	2.79
150	366	296	960	840	2.38
200	388	318	1,079	945	2.12
250	406	336	1,184	1,036	1.93

Temperatures Lower Than 212 Deg. F.

Surface temperature (deg. F.)	Difference between surface temperature and surrounding air (deg. F.)	Heat loss per sq. ft. per hour (B.t.u.)	Waste of coal in lb. per sq. ft. per year	Number of sq. ft. of surface that wastes a ton of coal in 1 year
100	30	56.6	49.6	40.3
120	50	97.5	85.4	23.4
140	70	142	124.3	16.1
160	90	190	166.3	12.03
180	110	242	212	9.44
200	130	298.5	261.5	7.65

The selection of the proper insulating material with due reference to its insulating efficiency and durability should follow a careful analysis of the conditions and requirements of the case under consideration. The greatest savings, of course, are to be effected by the proper insulation of the high pressure and high temperature steam lines.

Not every pipe covering is a good insulator, under all conditions; some may be effective at low temperatures and comparatively worthless at high temperatures. Again some insulators are fairly good on the initial application but soon deteriorate with age and the subjection to constant heat.

In the selection of an efficient covering it is highly important to consider its heat resisting qualities, mechanical ability to withstand ordinary wear and tear, and the effect of expansion and contraction of the pipes. To obtain more horsepower from the coal pile is the chief aim of all power plant managers and engineers and certainly after all that has been said and written on this most important subject of fuel conservation, those places in the power plant that spell "loss" will not be passed up and remain unnoticed.

Another appliance, which no doubt is overlooked and perhaps not considered as a losing factor is the steam trap. The loss of steam through open pet cocks or through leaky traps is quite large. This loss may be attributed to certain defects in the device and it is therefore highly important that they receive frequent inspection.

General Suggestions

The United States Fuel Administration made every effort to bring home to fuel users the gravity of the situation and the importance of coal and power economy, and only by the whole-hearted co-operation of all concerned in the operation of the plant can the desired savings be effected.

The call for men trained in combustion efficiency is now more insistent than ever before. Everywhere the cry is for greater fuel conservation, more efficient methods of firing and the elimination of waste. Therefore, the man whose training enables him to solve these problems scientifically is offered unlimited opportunities as well as setting a standard for his subordinate. The Fuel Administration during the war advocated keeping a record of the temperatures of the flue gases as they leave the boilers. It was stated that with this knowledge the engineer could find the highest working efficiency and immediately discover sources of waste, while without this knowledge operation is mere guesswork.

All chief engineers, operating engineers, and firemen know, or at least should know, that decreasing the temperature of chimney gases without wasteful excessive air admission minimizes coal consumption. The ending of the war has not changed the conditions of boiler operation. It is fully as imperative to save fuel now as it was while the war was on.

In summing up the whole matter of fuel conservation, it is highly important not to overlook what may appear to be the small matters, for example it has been found that scale only 1/50 in. thick on the boiler tubes often means a loss in heat transference of 9.4 per cent with the consequent additional cost for extra fuel. Again, the pressure continually dropping means only extra work for the fireman, sweating away with shovel and slice bar to hold the load, and perhaps a job cleaning the tubes every few days. To a trained observer, however, it may indicate conditions that no amount of tube cleaning will remedy, as hot gases short-circuiting through leaky baffle walls, cold air sweeping in through myriads of tiny cracks in the setting, clinker pitted, slowly cleaned fire boxes, condensation in the steam lines, improper manipulation of dampers, improper care and adjustment of heating systems. All these conditions can be corrected by giving them the attention they deserve.

TABLE 3—MINIMUM THICKNESSES OF STEAM PIPE INSULATION THAT SHOULD BE USED FOR GIVEN CHARACTER OF SERVICE

Steam pressures	Steam temperatures	Thickness of insulation for pipes larger than 4" in size	Thickness of insulation for pipes 2" to 4" in size	Thickness of insulation for pipes ½" to 1½"
0 to 25 lb.	212° to 267° F.	1" or standard*	1" or standard*	1" or standard*
24 to 100 lb.	267° to 338° F.	1½"	1½"	1" or standard*
100 to 200 lb.	338° to 388° F.	2" or double standard	1½"	1½"
Higher pressures	388° to 500° F.	2½"	2" or double standard	1½"
or superheat	500° to 600° F.	3"	2½"	2" or double standard*

For higher temperatures obtain special recommendations.

*Standard and double standard thickness apply to 85% magnesia insulation only—other thicknesses apply to all types of insulation.

It is always preferable to apply insulation greater than 1½-inch thickness in two or more layers with all joints broken or staggered.

The Diesel Engine in Railroad Service

May Soon Become an Important Factor In Heavy as Well as Suburban Traction

THE following article comprises an account of the extensive service which Diesel engines are performing in suburban passenger service in Sweden and a short outline of the possibilities of this form of prime-mover in heavy traction. We are indebted to a translation from Le Genie Civil of October 16, 1920, for the following description of the Diesel-Electric cars designed for suburban passenger service in Sweden together with a report of tests which have been conducted indicating a very economical fuel performance for these cars.

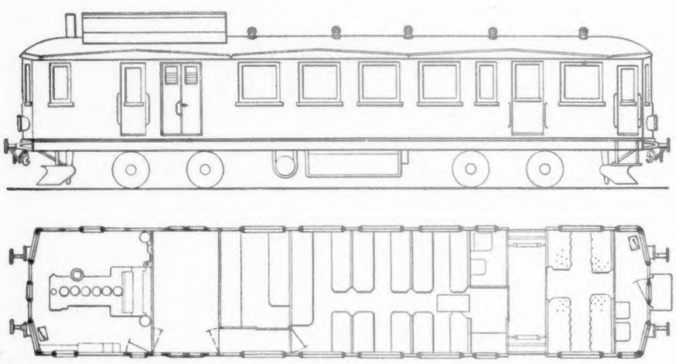


Fig. 1—Diesel Engine Composite Car

The second part of this article dealing with the broader phases of the Diesel locomotive as applied to heavy traction is contributed by Heinrich Schneider of Baden, Switzerland, who has made a close study of the Diesel locomotive for several years and has designed a number of improvements to this engine. In writing this part of the article it was the intention to outline briefly recent developments in the Diesel locomotive and draw particular attention to the great possibilities for the development of the Diesel locomotive in this country on account of its superior efficiency.

Diesel-Electric Cars on the Swedish Railways

Gasoline-Electric Motor engines have been studied for a certain number of years with a view to taking the place of motor engines or steam engines in surburban service. Although, up till now, this class of car is not widely distributed, it is nevertheless not without interest, especially in countries which are rich in liquid fuel, and its use may even be considered for traction on certain lines, like the trans-African lines, where coal and water are lacking and where electrification by means of overhead wire would incur expenses out of proportion to the traffic to be expected at the commencement.

Amongst the motors which may be installed on motor-engines of this class, with electrical transmission between them and the axles, the Diesel motors, which are today being extensively constructed in all industrial countries, offer the well known advantages of strength and economy which have caused them to be adopted on board submarines and numerous vessels. It is desirable, therefore, to give some consideration to various types of motor-engines of this kind, called for the sake of convenience "Diesel-electric," that have been running for some years on several lines of small Swedish railway companies.

There were no less than four different types, furnished with successive improvements, of these motor-engines working in Sweden between 1913 and 1917, which continued to run as long as it was possible to obtain the petroleum oils required for their motors. Moreover, they recommenced their service as soon as this period of scarcity was over. A statement of the characteristics of these cars will be found in the accompanying table. Each of these types includes a Diesel motor with six (or even eight) cylinders, direct connected to a dynamo which provides current for two motors mounted on the axles nearest the center of the car, or on those which are furthest from the Diesel motor.

In the first type, (Fig. 1), one end is arranged as an engine room with place for the engine-driver; then comes a baggage compartment, a postal compartment, a third class compartment (31 seats), a toilet, an entrance hall, a small second class compartment (10 seats), and finally a motorman's compartment for directing backward running. The second type differs little from the first, but it is lighter. Fig. 2 gives the plan of the third type, in which the Diesel motor is fitted in the middle of the car, while the two ends of the car are occupied by freight compartments or for postal service, and by the two motorman's compartments. Here the axles are independent, while the fourth type, in which the body of the car is similar to the foregoing, is mounted on two trucks, each of which carries a motor. The distribution of the loads is here symmetrical with reference to the center of the car. All the cars were supplied by the Générale Electric Company of Vasteras (Sweden) and the motors by the Atlas-Diesel Company. The following description specially concerns the third type, but the others only differ in the various disposal of the parts.

Diesel Motors

Some Diesel motors are 75, others 120 horse power. The first have six cylinders in line, the others six cylinders in V, and have speeds respectively of 550 and 500 revolutions per minute. Fig. 3 represents a 160 h.p. motor having eight cylinders. The crank shaft is completely enclosed in a gear-box which supports the two rows of cylinders inclined at 40 deg. The compressor for the injected air is worked by a crank at the end of the main shaft. The cylinders and yoke are cast in one piece. The valves are arranged in boxes which may be taken apart. The two opposite cylinders are slightly staggered in order to avoid the complication of forked connecting rods.

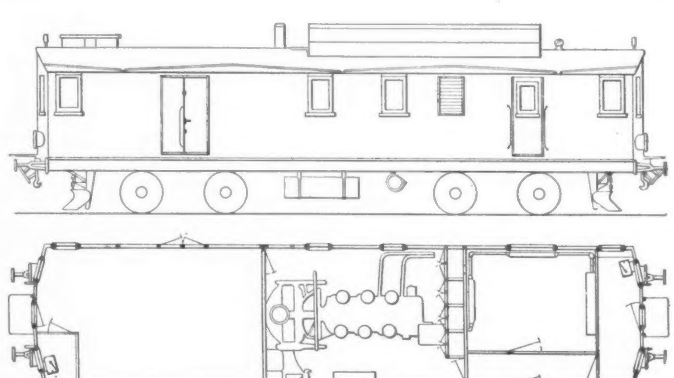


Fig. 2—Diesel Engine Express Car

The oil fuel is passed to the valves by a single pump, passing through distributors which allow any cylinder to be stopped. The regulation of the pump's output is effected by

a regulator which acts on the pump. The fuel is injected by air compressed to about 60 atmospheres, furnished by the compressor. As this compressor does not give any air until after it is started, there are reservoirs of air which are filled automatically while the motor is in motion. The burnt gases are carried by a collector to an exhaust box and come out above the roof of the car. The cylinders and the compressor are cooled by water circulated by a pump mounted on the end of the distributing shaft. This water is cooled in a radiator placed on the roof. In order to prevent the water from getting too cold, a wooden frame may be placed around the radiator, on which a canvas is stretched. At each end of this frame doors are placed which can be opened from inside the car to regulate the temperature of the water. It is possible, also, in winter, to let the water pass into the radiators of the car, for heating purposes.

The motor is oiled by means of a pump which takes the oil under pressure to all the bearings. Before returning to the pump this oil passes through a filter with a radiator, placed under the car, in order to cool it. Reservoirs for the water and the oil fuel are fitted under the ceiling of the car. They are filled by means of outside joints and hand pumps placed in the engine room.

The motor is set in motion electrically, by means of a storage battery placed below the car. At this time the dynamo works as a motor, and all the necessary connections are made automatically by turning the handle of the controller in the driver's cabin. On the motor is fitted a small compressor which gives air at approximately six atmospheres for the brakes, signals and distribution of sand. The following are the results of trials of the motor of a car in 1916:

Bore of cylinder: 200 millimetres.
Stroke: 240 millimetres.
Fuel: Texas oil.

	Trial No. 1	Trial No. 2
Duration of trial (minutes)	44	44
Load	100 per cent	110 per cent
Revolutions per minute	500	495
Horse power	120	132
Consumption of oil:		
Total (grams)	16,900	
Per hour	23,040	
Per horse power hour	192	
Pressure of air injection (kg. per sq. cm.)	56	

Electrical Equipment

The direct connected dynamo delivers its power direct to motors mounted on the axle, so that the whole power of the motor can be utilized no matter what the speed of the car. The dynamo is mounted on the same frame as the Diesel motor and is driven by means of a flexible elastic coupling. The dynamo gives a continuous current, the tension of which varies between wide limits up to about 550 volts. It has eight poles, and is furnished with commutation poles with excitation shunt and series windings (the latter is only in circuit when the generator is working as a motor, for starting the Diesel motor by the storage batteries).

The two traction motors are series motors, with commutation poles. They drive the two center axles by means of spur wheels. Their frames are completely closed, and divided into two halves, the lower of which can be turned down on a hinge; in this way the interior of the motor can be examined without raising the car. The motors are fixed

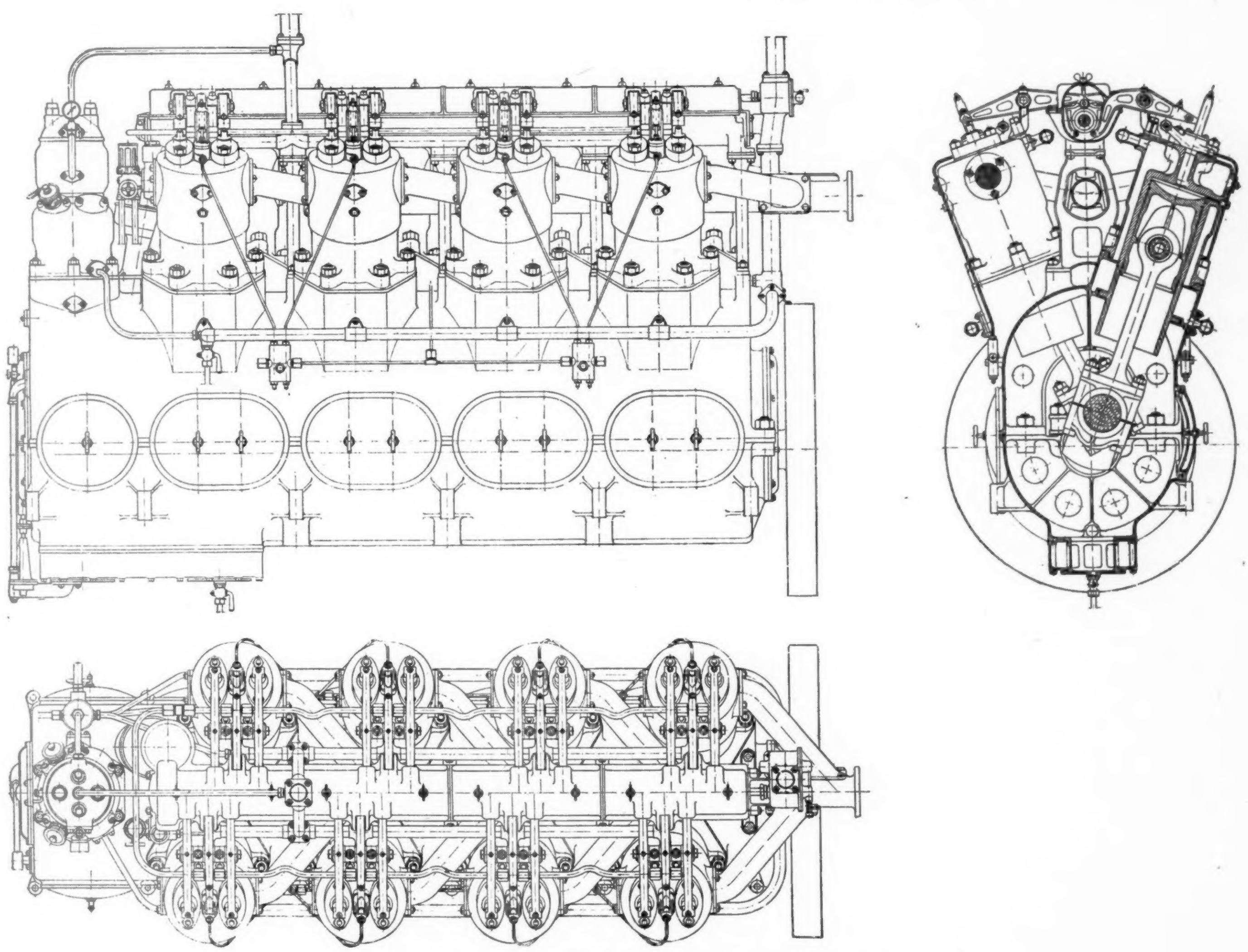


Fig. 3—160 H.P. Diesel Engine Designed for Railway Service

on one side by two bearings on the axle; on the other side the spring suspension allows the motors to follow the movements of the axles. In case of one motor breaking down, the driver can put it out of action from his seat and continue with the other.

Tests have shown that a 40-ton train hauled by a car of the first type, attains the following speeds:

On the level	miles per hour	33
With a gradient of 0.3 per cent		24
With a gradient of 0.6 per cent		17
With a gradient of 1 per cent		12

With a car of the second type, with the same motor power, but on a narrow gage, rather higher speeds are obtained. Types 3 and 4 are furnished with motors which are more powerful and intended for heavier trains.

In the motorman's compartment are placed all the instruments necessary for driving, applying the brake on the car and controlling the machinery. The controllers have two drums, one to change the direction of running and the other to regulate the speed of the car. The direction is changed with the Diesel motor at rest. The drum for changing the speed controls the starting of the Diesel motor, the connecting of the electric motors, and the variations of speed.

Under these conditions, the car is easily driven. On starting, the handle for changing the direction is turned as desired; the safety knob is depressed, and the handle for changing the speed is turned to the first notch, at which moment the Diesel motor is set in motion. At the second notch the connections for setting the storage batteries in action are cut; at the third notch the car starts. By continuing to turn the handle the voltage of the dynamo is increased, and therefore the speed of the car. On stopping the safety knob is released in order to stop the Diesel motor, and then the handle is moved back to the starting position. When the motive power is not required, in going down hill for instance, or when the train is at rest, the Diesel motor does not revolve, but it starts instantly when necessary; this, of course, causes a saving of fuel and lubricating oil, diminishes the wear of the machinery and does away with vibrations while the car is standing still.

The constant voltage current required for starting the Diesel motor and for lighting, is furnished by a storage battery under the car. This battery charges itself automatically during the running; it can also be charged while the car is at rest, by proceeding in the same way as for starting, but after having placed the switch at "charge" the traction motors are, in this case, cut off.

Results of Tests

In February, 1919, the following figures were obtained on a train comprising a Diesel electric motor engine of Type III, a passenger car with two trucks and a passenger car with two axles. There were 139 passengers in the train:

Weight, motor car	32.8 tons
Weight, passenger car with trucks	23.8 tons
Weight, car with two axles	16.0 tons
Total	72.6 tons
Weight, 139 persons (at 165 lb.)	10.4 tons
Total	83.0 tons

	Stockholm-Vasteras	Vasteras-Stockholm
Distance (miles)	69	69
Number of stations stopped at	8	8
Time during which car was running	3 h. 1 m.	2 h. 55 m.
Time during which motor was running	1 h. 59 m.	2 h. 11 m.
Ratio of these times (per cent)	65.5	74.5
Average speed per hour (miles)	23	24
Total consumption of fuel (kilogr.)	47.5	46.5
Consumption of fuel per 1,000 ton-miles,	18.9	18.6
the average weight of the train being 83 tons (pounds)	18.9	18.6
Density of oil fuel	0.815	0.815

Consumption of fuel reported during two weeks' working:

	1st week	2nd week
Weight of train (tons)	61.5	81.0
Consumption of fuel per ton-kilometre (grams)	6.11	5.38

Statistics from the service of six cars of 75 h.p., which were in use during the years 1913 to 1917, gives rather interesting information, as these statistics cover more than 650,000 kilom. In 1917, these cars were for the time being stopped on account of lack of fuel, but at the end of 1919 the distance covered was more than one million kilometres, which corresponds to a daily trip of more than 600 kilom. during four years and a half. The following are the results of these statistics:

Total distance covered (kilom.)	658,889
Number of days in use	4,380
Distance covered without trailer (kilom.)	395,664
Distance covered with trailer (kilom.)	263,225
Number of kilometres per day	150
Number of ton-kilometres	22,875,690
Average weight of train (tons)	34.8
Consumption of fuel per ton-kilometre (grams)	9.65
Consumption of lubricating oil per kilometre (grams)	11.95

These results are very encouraging, especially if compared with those obtained with other oil-electric vehicles, by which the specific consumption was generally at least double. On account of the low over-all efficiency of steam engines and of the high price of coal in Sweden, it has been estimated that, under the same conditions, a Diesel-electric train only expended about 6 per cent as much in fuel as a steam train. This has led to the construction of motor-engines with motors of 160 and even 250 h.p. A 250 h.p. motor will draw a train carrying 300 passengers.

Direct Drive Needed for Heavy Traction

In the discussion of the Diesel locomotive contributed by Heinrich Schneider, the author advocates the adaptation of the submarine type engine for locomotive service, with direct drive. The following is an abstract of Dr. Schneider's views:

For the highest economy the Diesel locomotive will have to be given serious consideration in the near future. In Europe mechanical engineers are quietly, though indefatigably working at the perfection of this style of locomotive. Owing to the wear and tear, the destruction during the time of war and the falling off in the production which still continues in several countries, the world is faced with the necessity for great renewals in all rolling stock, particularly locomotives. The increase of wages as well as the high prices for coal and oil necessitate that materially greater attention be paid to the economic consumption of fuel by locomotives than has been heretofore required.

Each style of locomotive has its special field of activity, and none will predominate everywhere. For street cars nothing but electric propulsion can be considered. However, the steam locomotive will be chiefly employed in thinly populated and mining districts, while the Diesel locomotive will find its greatest sphere of activity in poor coal districts. There is an unlimited field of activity for the Diesel locomotive in those countries and parts of the world with long railroads, scattered stations and low traffic density, such as South America, Africa, Asia, as well as India, China, Russia, etc., which are not highly industrialized, sparsely populated and without large coal deposits.

In various countries there is at present the desire to electrify all railways. However, this is only recommended for countries which like Switzerland can utilize easily exploited water power. In other countries where electric power is to be generated from coal or oil, expensive electric power stations, collector installations, etc., and very expensive electric locomotives are required for the electric railway installations. Such installations, can, therefore, only be considered for countries of highly cultivated industry and large population as in Europe and parts of the United States, while for all other countries the building cost and working expenses of these installations are very extravagant. It is here that the Diesel locomotive will be found to be greatly superior to electric railway traction.

As with the automobile for which electric propulsion has answered in city traffic only, propulsion by combustion engines has proved far superior in all other departments.

The construction of the Diesel locomotive has been tried for many years. Diesel, himself, in describing his motor in 1897 pointed out the following advantages offered by the Diesel locomotive: "The concentration of great capacity in a locomotive requires, for economy, long and heavy trains. With the oil motor locomotive, however, the greatest economy would be obtained with short and frequent, as well as separate passenger, freight and goods trains." Scherl with his single rail railway, with frequent light and high speed trains points out the same thing.

No material progress has been made for the last 30 years in the development of the steam locomotive as to the utilization of heat. It is only by the insertion of the superheater that a nominal improvement has been achieved in the utilization of fuel. The rapidity with which all railway companies have seized upon this innovation shows their eagerness to improve the economy. The superheater increased the utilization of fuel by 10 to 20 per cent while the Diesel locomotive allows of an increase of the utilization of fuel of upwards of 200 per cent compared with the exhaust steam engine. There are, however, some firms in central Europe at present building experimental locomotives with steam turbine drive and condensation installation and this may bring improvement in the consumption of fuel compared with the exhaust steam locomotive engine.

If we but view the construction of marine engines and motor cars which likewise forms a part of the system of communication, we find that the progress of railways has conspicuously lagged. It is to be expected that in the course of some years a considerable development will occur in this field. About 12 years ago the first, and so far the only, Diesel locomotive was turned out in Europe, displaying on its trial trip, a capacity of about 1,000 h.p. and a speed of 100 km. (62 miles) per hour. Trial trips were made with this locomotive from Berlin, and it is to be regretted that nothing was published in regard to the result. For the purpose of starting there was an auxiliary compressor of ample capacity installed on this locomotive. However, it appears that the difficulties in starting were nevertheless so great as to have prevented the construction of further Diesel locomotives of this description. To overcome the starting difficulties arising out of the direct propulsion by the Diesel locomotive, electric transmission of the oil engine output to the driving shafts has been suggested. This arrangement, which was at first intended for narrow gage railways only, has found employment in benzol and oil dynamo motor cars, Important firms have of late developed this construction so far that it can already compete with the electric motor car and the steam locomotive.

In the matter of trunk line locomotives of highest capacity, however, there can be no talk of electric transmission since electric motors would assume such large space and weight as to require a whole motor car to themselves. The direct transmission of the Diesel engine is considerably cheaper and more simple.

The great possibilities of the Diesel locomotives have been recognized for a long time past, though almost unsurmountable difficulties have opposed their construction. These, however, may now be looked upon as having been overcome owing to the remarkable evolution of oil engines during recent years. The following are the conditions that must be met in the construction of reliable Diesel locomotives:

1—A reliable, reversible and high speed Diesel motor is required.

2—Ability to start the train by means of an oil motor, bearing in mind that oil motors will not start under load.

3—Special construction must be devised for the accommodation of the motors and driving mechanism.

It is one of the objects of this article to state what has been accomplished toward meeting these several requirements. In the approved engine of the submarine boat we find the actual construction of the locomotive driving engine ready for use. Cylinder dimensions, stroke, and rotation figures are almost the same. Both valve motion and governing apparatus remain the same, although the labor of adapting this to the railway service is not to be underrated. The starting difficulties have been solved by a number of recent inventions, only a portion of which have been made public.

The greatest difficulty in regard to starting has been overcome by the insertion of liquid gears of two different types. By the employment of liquid and mechanical gears the limit put upon the direct driven locomotive by the number of revolutions, the stroke and piston pressure is extended. A particularly hopeful design may be mentioned in which the starting apparatus consists of but one rotating part, so that a considerable increase in speed is possible. Furthermore, there is a design which with some slight alterations will make it possible to use the submarine boat engine for locomotives.

America, as the richest oil producing country in the world, with her highly cultivated industries, her great financial resources and her tremendous railway system is the very country for the Diesel locomotive. It is therefore difficult to realize why America has hitherto paid so little attention to the construction of oil engines. As we may presume that the reason for this lies in the fact that, until the transformation of the economic state of things brought about by the war, there was a superfluity of cheap fuel, so that the economical oil motor met with delayed consideration in America as compared with Europe where the high prices for combustibles gave rise to a much earlier search for a more economical engine.

At present strenuous efforts are being made in the states to replace the steam drive in shipbuilding by the oil motor drive for which the large marine oil engines must be developed. The steam locomotive is much less economical than the stationary or marine steam engine or turbine and yet these have been replaced by the oil engine for some time. If America wants to extend her dominating position in industry to the construction of heat engines, she will be obliged to take up the construction of Diesel motors and oil motor locomotives.

Central Europe engaged vigorously in the construction of the Diesel motor locomotive before the war but all such endeavors were interrupted by the outbreak of hostilities. Although Germany is economically overthrown, there are several influential German firms who are energetically pushing the construction of oil motor locomotives. Hence Germany appears to keep up the lead in the construction of combustion engines in spite of the breakdown she has suffered. It is high time to get rid of prejudices concerning the oil motor locomotive because of its apparently insurmountable difficulties, seeing how similar mistaken ideas were entertained for so many years about the Zeppelin airship. The oil motor with a capacity equal to that of the locomotive engine is already available. Owing to the issues of the war, the world enjoys the benefits of the experience with the construction of the submarine oil engine, so that America is now in a position to utilize this.

That the evolution of the Diesel locomotive engines will take years is considered a matter of course by every authority, but we should commence all the sooner with studies and preparatory labors for the oil motor locomotive engine puts the highest claims on the engineering art. The conclusion to be arrived at from these observations is that there are no longer any insurmountable technical obstacles in the way of the construction of the oil locomotive and that there is an economical necessity for substituting the far superior oil locomotive for the steam locomotive.

Controversy Before Labor Board Continues

Situation Forcefully Presented by Atterbury; Brotherhoods Fail to Secure President's Intervention

THE immediate abrogation of all national agreements, the remanding of the question of rules and working conditions to negotiation between each carrier and its own employees, the re-establishment of the agreements, rules and working conditions in effect on December 31, 1917, and the right to pay unskilled labor not less than the prevailing rate of wages in the various territories served by any carrier, were requested of the Railroad Labor Board on January 31 by General W. W. Atterbury, vice-president of the Pennsylvania and chairman of the Labor Committee of the Association of Railway Executives. The request was accompanied by a vigorous statement of the present precarious financial position of many of the carriers, General Atterbury predicting bankruptcy for many and a resulting financial panic unless steps are taken immediately to cut needlessly huge wage payments and thus bring operating expenses into proper relation to the operating revenues now accruing under increased freight and passenger rates.

At the close of General Atterbury's statement, which has been generally quoted in the press, H. T. Hunt, a member of the public group on the Board, and Judge R. M. Barton, chairman of the Board, suggested that representatives of the railroads and the employees meet to formulate means, if possible, to avert the disaster predicted by General Atterbury. To this suggestion the latter replied that negotiation would be futile because of the dissimilarity of the views of the executives and of the employees and because of the necessity for immediate action.

Chairman Barton then stated that the requests made by General Atterbury would have to be considered in executive session but, in reply to a question of B. M. Jewell, president of the Railway Employees' Department of the American Federation of Labor, he said that representatives of the employees would be heard before any action was taken by the Board. Mr. Jewell and other representatives of the employees present at the hearing declined to reply to Mr. Atterbury's requests or to make any statement at that time. Mr. Jewell, however, stated that he would prepare a reply on behalf of the employees to be presented to the Board later.

General Atterbury's statement was made after the Labor Committee of the Association of Railway Executives had been in session at Chicago for three days discussing the present labor situation and formulating plans for the restoration of conditions under which an honest day's work for an honest day's pay might be rendered by railway labor.

Various of the "independent" railway organizations have been fighting since the beginning of the present hearings for the right to present their views regarding national agreements independently. On February 2 the Board's decision on their petitions was made public, representatives of these organizations being granted the right to be heard in the present case despite the opposition of the larger brotherhoods who have maintained that the members of the independent organizations are adequately represented by them.

Appeal to President Wilson

The vigorous stand taken before the Railroad Labor Board by General W. W. Atterbury, vice-president of the Pennsylvania and chairman of the Labor Committee of the Association of Railway Executives, against the continuance of national agreements brought forth talk of general railroad strikes, charges and answers. The matter finally reached President Wilson, whom representatives of the labor organization petitioned for the presentation of the issues involved to Congress and representatives of the carriers followed with specific answers to the charges made by the labor leaders.

The executives of the brotherhoods filed long telegrams to the President, declaring that they did not believe that the carriers were in the financial condition outlined by General Atterbury and attacking the latter for "violating all decent proprieties, disregarding the Transportation Act and flouting existing agencies such as the Interstate Commerce Commission and even Congress itself."

"General Atterbury's policy," the telegram charged, "is to disrupt labor unions, turn public opinion against the employees and place wages on a previous basis so that railway profits might be enhanced when prosperity returned."

In support of these contentions, the telegrams reiterated the charges of mismanagement and control by a New York banking group which have been made repeatedly during the past month by various labor leaders and which are under investigation by the Interstate Commerce Commission.

The charges made in the employees' telegram were immediately answered by T. DeWitt Cuyler, chairman of the Association of Railway Executives, in a telegram to the President.

President Wilson on February 6 replied to the telegrams addressed to him by the railroad labor leaders and the railroad executives at Chicago last week, declining to interfere in any way, during the last month of his administration, in the controversy between the railroad executives and the labor leaders regarding the abrogation of the national agreements. The labor leaders had asked for a Congressional investigation of the railroad situation but the President in his reply indicated confidence that the case is now in the hands of the proper tribunal and he therefore referred the copies of the telegrams to the board and to the Interstate Commerce Commission for such action as they may deem wise. The President's action was taken on recommendations made to him by John Barton Payne, director general of railroads, to whom the telegrams were submitted on their receipt last week.

B. M. Jewell, president of the railroad department of the American Federation of Labor, declared that the president's message was a complete vindication of the stand taken by the unions in that it "makes it perfectly clear that the board should confine its jurisdiction strictly to the controversy as to wages and working conditions, leaving financial matters to the Interstate Commerce Commission."

Atterbury Replies to Jewell

W. W. Atterbury, Chairman of the Labor Committee of the Association of Railway Executives, issued a statement on Tuesday in reply to the assertion of B. M. Jewell, representing the employees, that President Wilson's reply meant that the Board would consider only wages and working conditions, and that financial questions would be considered by the Interstate Commerce Commission.

"His hope that the financial results of existing rules and working conditions can be hidden from either the Labor Board or the public will not be realized," said Mr. Atterbury's statement.

"He would maintain indefensible waste and inefficiency even at the cost of destroying the earning power of the railroads or of compelling them to go to the Interstate Commerce Commission for still higher rates.

"The producers and consumers of the country cannot support Mr. Jewell's program. It requires no conspiracy against union labor to explain their attitude or mine. The railroads are struggling to regain the reasonable productivity of a considerable part of their employees, now seriously impaired by the rules and working conditions coming over from the war. That conspiracy is the conspiracy of the entire country."

This reply was followed in turn by the issuance of two statements by General Atterbury in both of which he presented evidence to sustain his contentions made before the board on January 31.

While both the carriers and the employees were publicly defining their respective positions in this controversy, Mr. Jewell petitioned the Labor Board for additional time in which to prepare his reply to General Atterbury's requests. This petition was opposed by E. T. Whiter, who presented a letter on this subject written by General Atterbury and vigorously opposing any further extension of time. After consideration in executive session, however, the Board granted Mr. Jewell's request and February 10 was set as the date upon which he would be heard.

Mr. Jewell in the interval granted him to prepare a reply to General Atterbury, repaired to New York and retained Frank P. Walsh, the labor counsel, and W. Jett Lauck, economist, and a battery of publicity men to assist in bringing a conspiracy charge before the Board. Mr. Jewell planned to ask for postponement of consideration of the question of national agreements and for a hearing upon the evidence the unions wished to present in support of their charge that railway executives and financiers have conspired to re-establish autocratic control of the transportation industry.

Chairman Barton in opening the session on February 10 read a resolution passed by the Board which prohibited the presentation of such evidence and which pointed out that the Interstate Commerce Commission is the proper body before which to present such charges.

Board Denies Immediate Abrogation of National Agreement

The Board's resolution also denied General Atterbury's requests for immediate abrogation of the National Agreements and for the right to pay unskilled labor the prevailing rate in the territory where they are employed. The resolution, after reciting the history of the present case, stated that the Board must hear all of the evidence before ruling on the National Agreements and that it was powerless to grant General Atterbury's request regarding unskilled labor because the matter has not been brought before the Board according to the procedure outlined by the Transportation Act.

After a short recess Mr. Walsh began a presentation on behalf of the employees. He confined his remarks to replies to General Atterbury, attacking the Pennsylvania and charging that his statements are misleading. That the railroads are in a precarious financial condition was denied by Mr. Walsh, although the statement was not accompanied by proof.

B. M. Jewell, appearing before the Railroad Labor Board at Chicago on February 17 in the resumption of hearings in the controversy over National Agreements, asked that the Board take the following steps immediately:

"First: That the Board refer the National Agreements which are now before it to a joint conference of the representatives of the railroads and of the labor organizations with the recommendation that their disagreements be adjusted by negotiation as soon as possible—the Board agreeing to pass immediately upon any points of difference which may arise from the negotiations.

"Second: That the Board request the representatives of the railroads and representatives of the labor organizations to meet the Board in conference to consider the establishment of boards of adjustment as contemplated by the Transportation Act.

"Third: That in reply to Mr. Atterbury's notice to the Board and his subsequent letter to the chairman advising him that he contemplates filing a flood of individual complaints to reduce the wages of unskilled employees, the Board recommend to Mr. Atterbury that he meet in general conference with the representatives of the employees affected so that the existing General Agreements will not be impaired and the matter brought to the Board in the form of a single complaint."

Mr. Jewell declared his constructive proposals were brought forward with the following objects in view:

"1. To insist upon the fundamental principle of collective bargaining which is now the real issue before the Board in our pending cases.

"2. To expedite the cases which otherwise will absorb a vast amount of time and effort.

"3. And to restrain Mr. Atterbury and the railroads from preventing the proper functioning and destroying the effectiveness of this Board by flooding it with a large number of individual complaints which it cannot handle."

Mr. Jewell also asked that a conference be called immediately between the railroad labor chiefs in Chicago and the members of the Association of Railway Executives.

Executives Denounce Conference Plan

The Association of Railway Executives at a meeting on February 18 unanimously adopted the report of its labor committee and passed resolutions refusing to enter into national conferences suggested by the employees as a means of settling differences over wages of unskilled labor and working conditions.

The executives denounced the employees' proposed conferences as a plan by labor leaders to bring about nationalization of the railroads.

The committee report pointed out that the opposition made by the roads to the National Agreements and the position taken today was not to be construed as an attack on labor organizations themselves.

"The railroads are confronted with this situation—while endeavoring to escape from one set of rigid and uniform rules and working conditions inherited from the war they are met with a new demand, which, if acquiesced in by the Labor Board, would deprive individual carriers of direct negotiations with their own employees."

Replying to statements by labor leaders that the railroads' suggestion to abrogate the National Agreements was part of a plot originating in Wall street to break down the labor organizations, the report said:

"The record demonstrates that the railways have acted throughout independently, primarily in their own interest, but also in the interest of the shippers and farmers."

Atlanta, Birmingham & Atlantic Case

The efforts of the Atlanta, Birmingham & Atlantic to secure authority to reduce the wages of its employees below the rates set by the Board's decision of last July have attracted much attention, the case coming before the Board simultaneously with the introduction of General Atterbury's evidence in the National Agreements hearings outlining the precarious financial condition of many of the carriers. The case is also viewed with interest inasmuch as the rulings of the Board in this case will undoubtedly establish precedents which will serve to guide the Board, the carriers and the labor organizations in preparing, submitting and arguing future cases of this character. It is not, however, considered in the light of a test case by railway executives.

The Atlanta, Birmingham & Atlantic had ordered a cut in the wages of its employees effective on February 1 because of its inability to meet its operating expenses. Despite drastic reductions in working forces and in train service the carrier was losing about $100,000 a month. The employees

objected to the wage cut and, when conferences were held between their representatives and representatives of the carrier, a controversy arose as to whether the wage reduction could be made effective, under the terms of the Transportation Act, pending a decision by the Labor Board. The representatives of the carrier held that the wage cut was unavoidable and would have to be made on the date announced even though the Board had not reached a decision on the employees' appeal. The employees held that the existing rates of pay should be continued until the Board had made its ruling.

When the case came before the Labor Board on January 25, the employees refused to present evidence in the case until the Board had instructed the carrier to rescind its wage cut order. The representatives of the carrier after presenting voluminous evidence showing the financial condition of the road, held that they had not violated the spirit or letter of the Transportation Act in cutting their wages first and then coming before the Board. Subsequently the Board passed a resolution upholding the employees' contention and ordering the carrier to rescind its wage cut order.

Following the precedent established in the Atlanta, Birmingham & Atlantic case the Board issued an order on February 14 directing the Erie to rescind its recent order reducing track laborers' wages, re-establishing the seven-day week for train despatchers and deducting the January 31 earnings of telegraphers. The order was to have been effective on February 1.

Fatal Gasoline Explosion at Memphis*

On January 24, 1921, vapors from a tank car of casinghead gasoline on the Union Railway spur on Front street, Memphis, Tenn., became ignited and resulted in a blast that killed 11 people and badly injured 19 others. Probably 40 or 50 men, women and children received slight injuries from falling debris or from burns. The explosion wrecked an oil plant, levelled a block of frame buildings and broke window panes within a radius of five blocks, the estimated loss being $200,000.

Shipments of casinghead gasoline began about 10 years ago and the records of the Bureau of Explosives show this disaster to be the sixteenth serious accident that has resulted from the removal of the dome cover while interior pressure exists in the tank.

The gasoline contained in the car was a volatile product known as absorption gasoline with a gravity of 81.5 deg. Baumé, initial boiling point of 80 deg. F. and end point of approximately 360 deg. F. The car was spotted on Saturday, January 22, and the following Monday morning, January 24, a negro workman at the plant opened the tank car without relieving the pressure within. The pressure of vapors that existed in the car is not known although it has been said that the relief valves had been giving off vapors previous to this time. This statement has not been verified but probably there was a pressure of nearly 25 lb., at which the valves popped. The removal of the dome cover resulted in the sudden relief of pressure and gasoline vapor and liquid gasoline boiled out of the dome head in large quantities. The wind from the west in carrying these vapors across the street, mixed them with air and formed readily ignitable mixtures. The vapor became ignited by open fires in the frame buildings on that side of the street and instantly there was a terrific explosion which demolished every house on the west half of that block, as well as destroying buildings in the blocks north and east. This explosion was followed by a second and more muffled one which was made by the flame flashing back to the tank car where vapors issuing from the dome caught fire and burned as they came out. The damage on the west side of the track in the oil plant itself was due largely to the fire that followed. This fire caused the destruction of a garage containing four automobiles, the ruin of a warehouse of sheet iron construction and the loss of several hundred barrels of oil and grease stored therein. These drums of oil caused several minor explosions and, upon breaking, burned with intense heat.

To add to the danger of the fire, there were seven 11,000-gal. tanks filled with gasoline and kerosene, which stood opposite the garage in the oil plant, and five more tanks elevated against a concrete wall at the west side. A second car of absorption gasoline, spotted at the same time as the one which exploded, was vented and the escaping vapors burned. The storage tanks also were vented at the top with nipples enclosing wire gauze and as vapors formed and passed out of these vents into the air, they burned quietly. Neither the second tank car nor any of the tanks were damaged in any way. It is interesting to note that after the fire had been extinguished, the car from which the explosion originated was still about half full of gasoline. The car was damaged only slightly and the wooden foot boards were only partly burned.

The investigation of the accident showed that the colored employee, Andrew McKinley, removed the dome cover without paying attention to the positive directions on the dome placards pasted over the dome cover joint and cautioning that the dome cover should not be removed until after release of all interior pressure in the tank. When he succeeded in unscrewing the cover it was thrown into the air by interior pressure in the tank and a column of gas and liquid was forced vertically upward to a height estimated by witnesses to be about 100 ft. The dome cover contains vent holes under the flange and above the threads, the object of which is to make it impossible to completely unscrew it without evidence of interior pressure furnished by the noise of vapor escaping through these vents. Witnesses 100 ft. or more away from the car testified that a hissing noise of growing intensity was heard while McKinley was engaged in unscrewing the cover. This warning as well as the warning of the dome placard was disregarded.

The serious results of this explosion demonstrate once more the need for ceaseless vigilance in handling tank cars of gasoline or other volatile liquids which may explode. In handling gasoline, the Interstate Commerce Commission regulations require that a car, when loaded, must have a certain voidance above the gasoline. This voidance is to take care of any expansion of the liquid which may occur if it becomes heated in transit. Safety valves are provided which will relieve any pressure above 25 lb. within the car. These valves should always be opened before the tank car is unloaded. In case pressure develops, the car can be sprayed with water and the resultant cooling will condense the greater part of these powerful vapors, thus reducing the pressure measurably.

Another way to relieve the pressure is by leaving the valve open and allowing the gas to dissipate slowly. In addition, there are in the dome cover several holes above the threads which will allow the escape of vapors before the cover is entirely removed, thus warning a man when there is pressure within. In no case should the dome cover be removed until this pressure is relieved.

*The account of this explosion is taken from a special bulletin issued by the Bureau of Explosives and the report of an investigation conducted by the Department of the Interior, Bureau of Mines.

"Only about 9 per cent of the country's factories are properly illuminated," says Industrial Power. "Thirty-five per cent of our factories have not changed their lighting systems in five years, notwithstanding that the lighting art has been revolutionized during this time. In other words, 35 per cent of America's industrial plants are five years behind the times in a matter that may affect their output anywhere up to 35 per cent."

Virginian Gondola Car of 120 Tons Capacity

120-Ton Cars Now in Service on the Virginian

Gross Load Behind Tender Increased from 7,950 to 13,200 Tons; First Application of New Six Wheel Truck

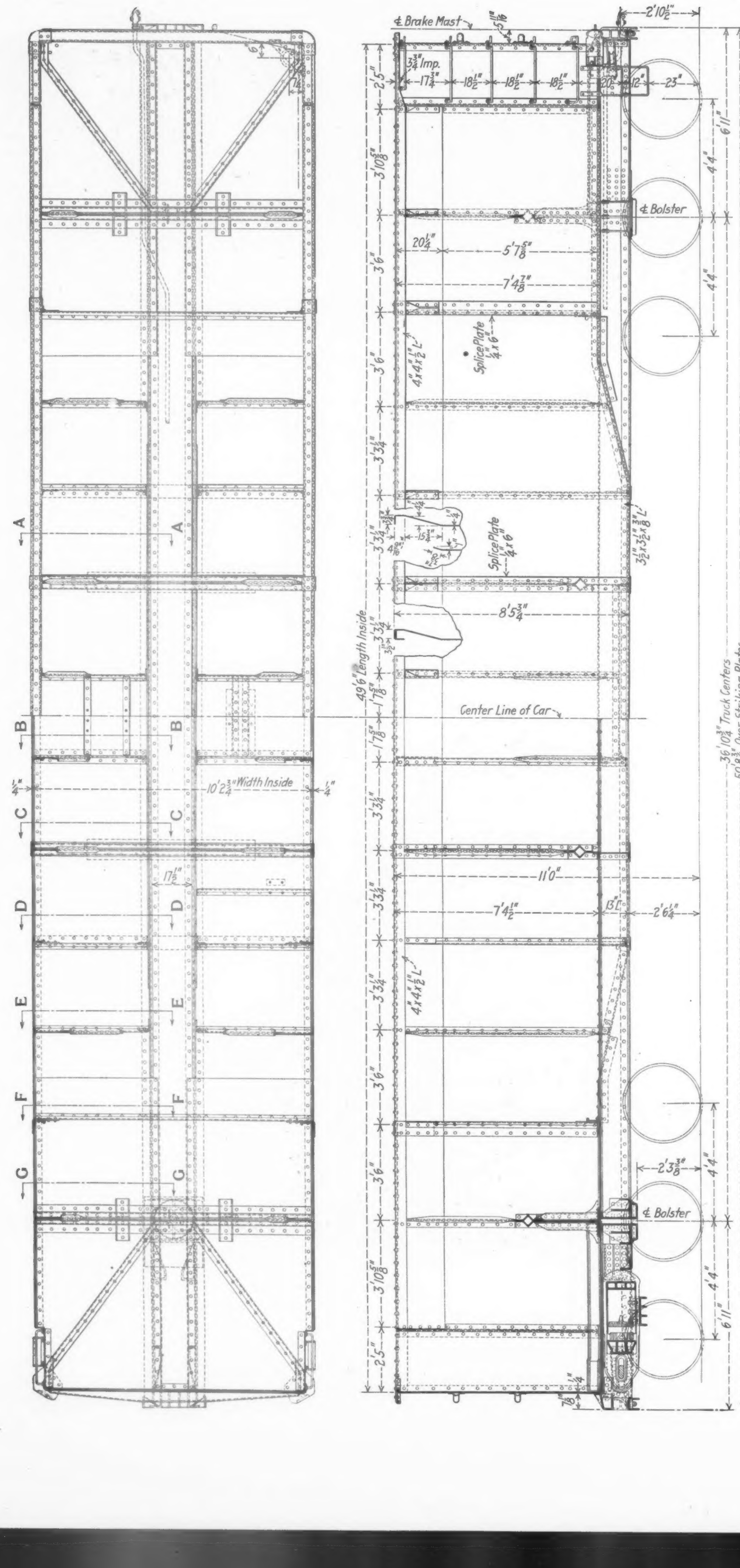
THE Virginian Railway has recently received from the Pressed Steel Car Company at Pittsburgh, 1,000 steel gondola coal cars of 120 tons capacity. This equipment is the heaviest in the history of transportation and is notable for two reasons: First, because it is the first instance where a large number of cars of such extremely high capacity have been placed in service, and, second, because the equipment has been developed especially to meet the operating conditions on the Virginian road.

Interior of the Car Body, Showing Gusset Side Stakes, Bolsters and Cross Bearers

The circumstances that led the Virginian to go from the use of 55-ton cars to 120-ton cars are worthy of comment. Of the total traffic handled by the Virginian, 92 per cent is coal, moving to tidewater and inland points from mines west of Princeton, West Virginia, the greater portion of which moves to Sewalls Point pier, 342 miles from Princeton. The profile consists principally of slight descending grades; thus the tonnage that can be handled in a single train is limited over a large part of the line, not by the tractive capacity of the locomotive, but by the difficulty of securing proper operation of the air brakes in the handling of long trains on descending grades to avoid break-in-twos.

Since such a large proportion of the traffic consists of tidewater coal, the normal operation of the road depends upon the ability to dump cars promptly on arrival at the pier. In order to secure the maximum capacity of the pier duplicate unloading facilities have been provided. Two separate car dumpers, one handling a 55-ton car and the other two 55-ton cars, or one 120-ton car, dump into electrically operated conveyor cars. The conveyor cars from one dumper are drawn by a cable hauling system up an incline to the top of the pier, from which point they are moved by electricity to the proper chute and the coal dumped through by air pressure. The other dumper is served by an elevator that lifts the car to a track running over the pier pockets.

Under normal conditions the Virginian moves a large proportion of its traffic in its own equipment, consisting principally of gondola and hopper cars of 55 tons capacity and, latterly, 120 tons capacity. Two of the former cars can be handled on the two-car dumper, or one 120-ton car, from which it will be noted that the adoption of a car carrying



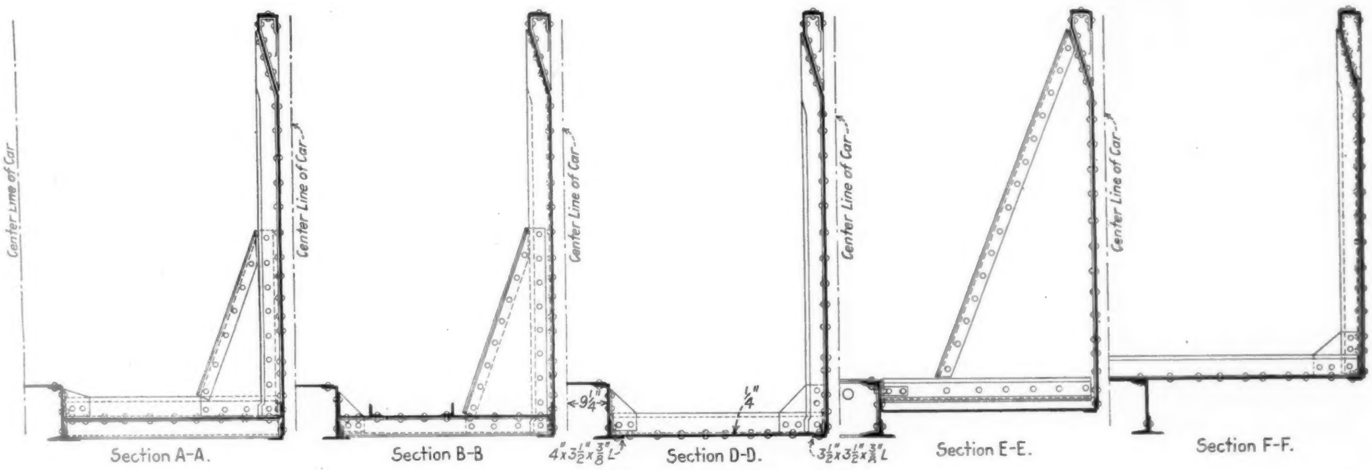
Plan and Side Elevation of the Body of the Virginian 120-Ton Car

a less load would have the effect of reducing the capacity of the dumper and the efficiency of the pier. With this in mind, plans were made for the development of equipment having twice the gross weight of the 55-ton cars. In 1917 four sample 120-ton cars were placed in service to determine whether the use of such equipment would be practical and economical, and, as a result of these experiments, the order for 1,000 cars of this capacity was placed in the spring of 1920, immediately after the roads were turned over to the corporations.

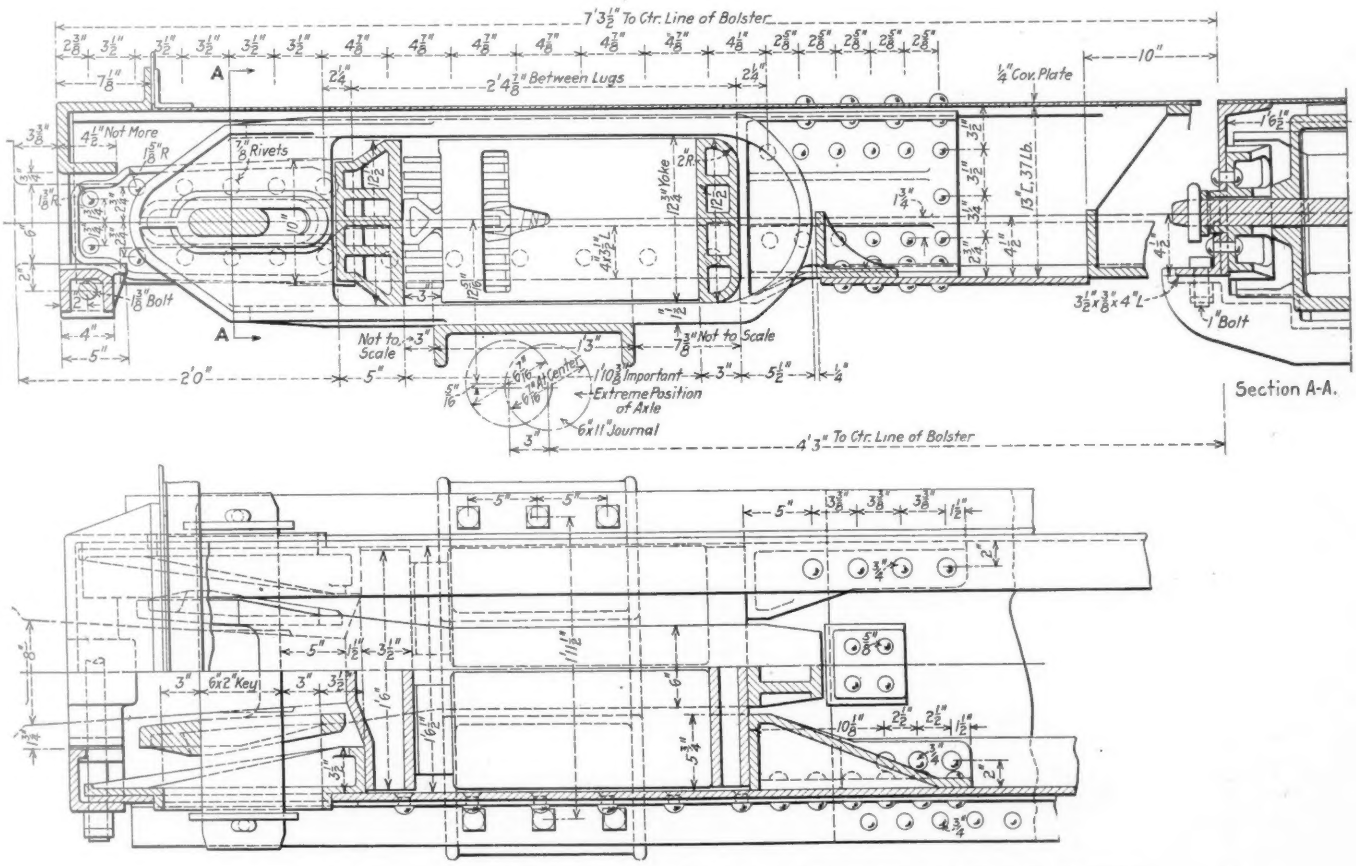
The advantages of the 120-ton car under the conditions prevailing on the Virginian Railway can be judged by the comparison of this equipment with the 55-ton cars. The new cars, with a capacity of 240,000 lb., weigh 78,900 lb., making the ratio of load to dead weight 75.3 per cent. The gondola and hopper cars, with a capacity of 60 tons, weigh 41,000 lb. and 44,000 lb., respectively, making the ratio 74.5 and 73.2 per cent.

The 120-ton cars are 49 ft. 6 in. long inside, while the 55-ton hopper cars are 32 ft. 6 in. long and the gondolas 40 ft. long. Thus the gross weight per foot of length for the 120-ton cars is 61.7 per cent greater than for the 55-ton gondola, and 31.0 per cent greater than for the hopper. For a given length of train the net tonnage that can be handled in the larger cars is even greater.

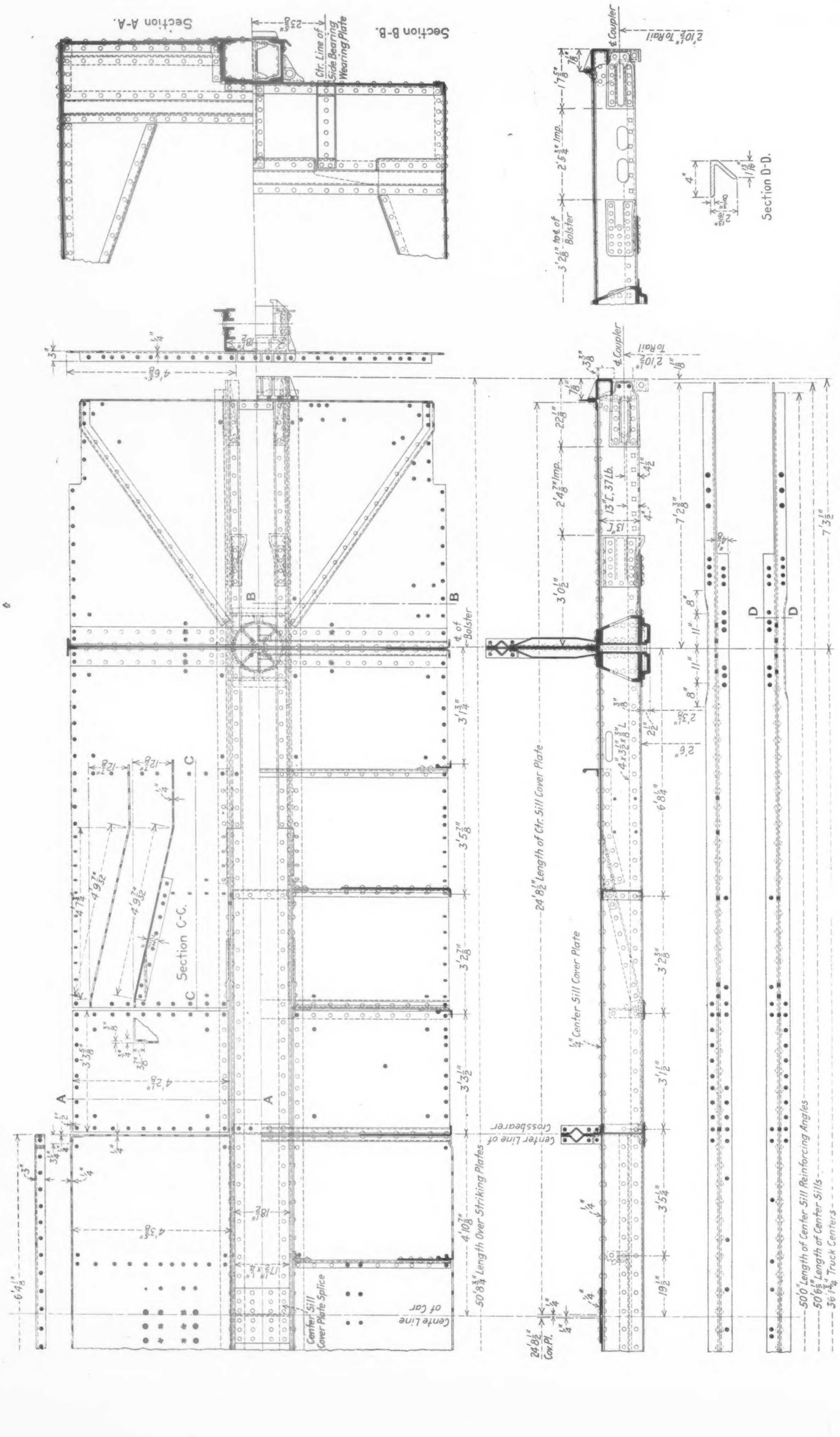
It has been found entirely practical to handle trains of 120-ton cars, but no extensive tests have been made so far because of adverse weather conditions. It has been demonstrated, however, by actual test that the gross load behind the tender in these trains averages 13,200 tons, compared with



Cross Sections of the Car Body



Wide Sill Spacing Permits the Application of Two Westinghouse N-12-A Draft Gears



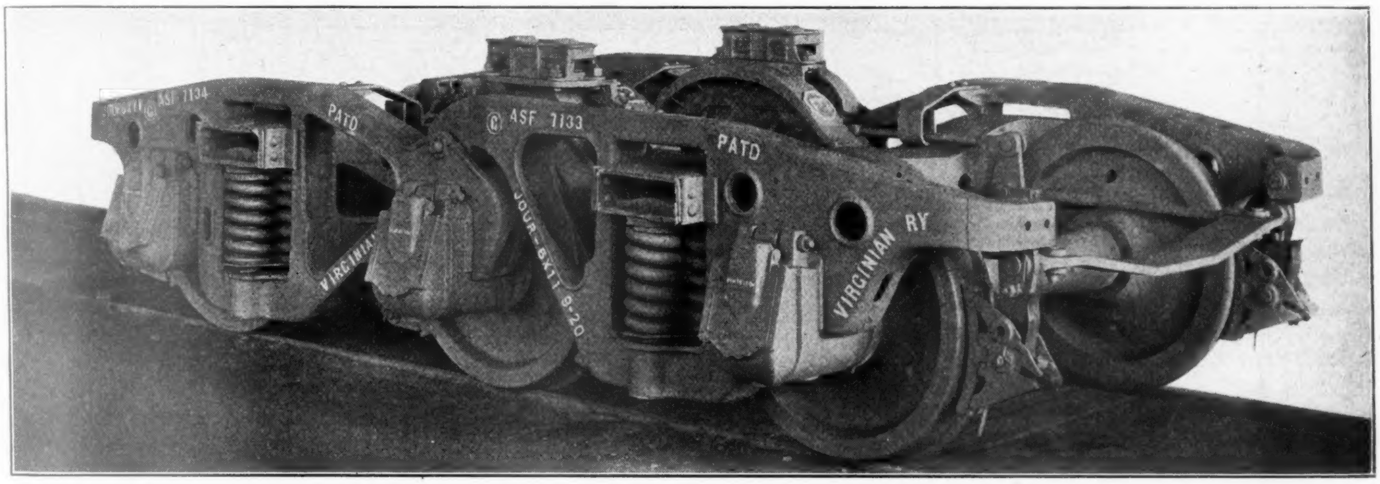
Details of the Underframe and Floor Construction, Showing Draft Arrangement for Westinghouse and Cardwell Gears

7,950 tons hauled with the smaller equipment. It is the opinion of the operating officials that with favorable weather conditions a train haul of 14,000 tons gross or 10,540 tons net load will be secured by the use of the 120-ton coal cars.

Construction of the Cars

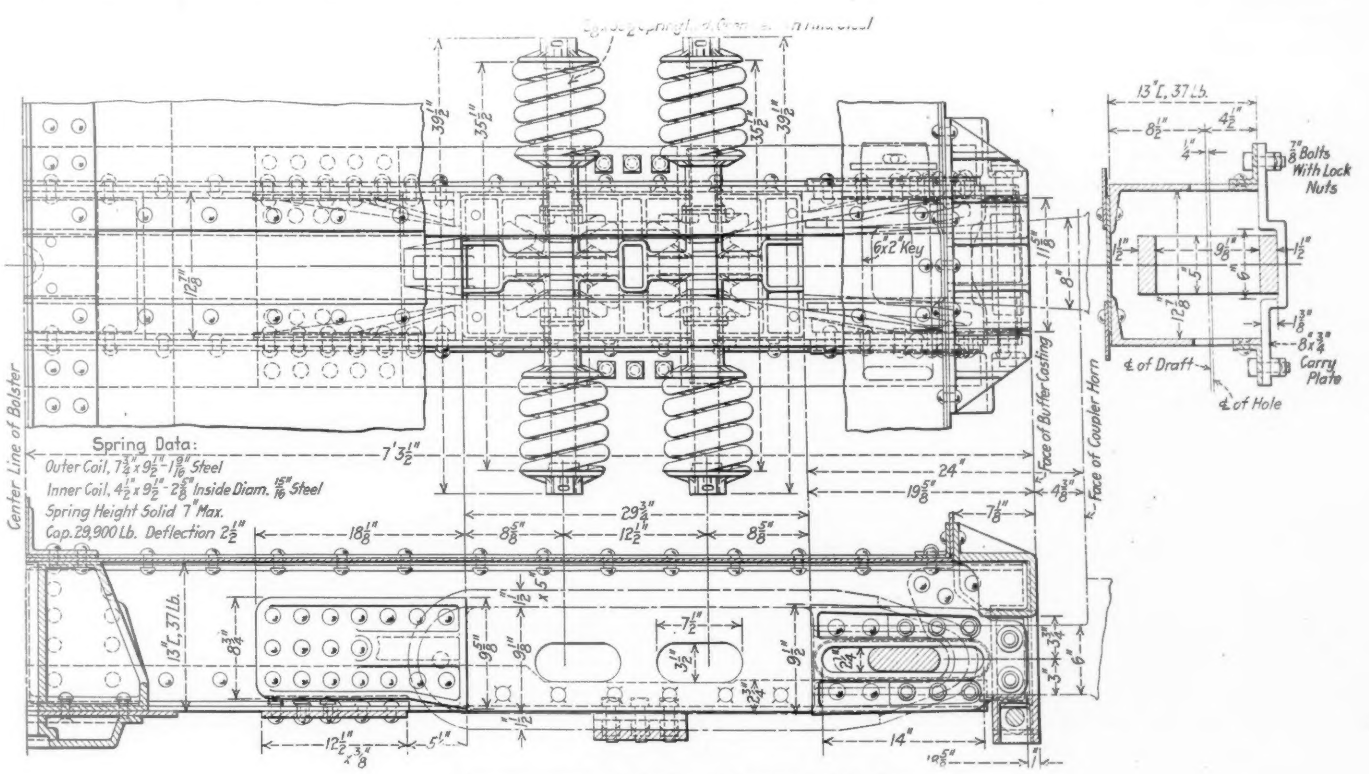
As already mentioned, these cars have been made extremely wide and high in order to keep down the length.

The car body is 49 ft. 6 in. long by 10 ft. 2¾ in. wide inside and has a depth at the center of 8 ft. 5⅛ in. and at the ends over trucks of 7 ft. 4¼ in. The cubical capacity



The Lewis Truck

is 3,850 cu. ft. level full or 4,450 cu. ft. with a 30 degree heap. This latter figure, with coal at 54 lb. per cu. ft., is equivalent to approximately 240,000 lb. The cars are stencilled 218,000 lb. capacity, but, adding a 10 per cent overload, brings the capacity to approximately 240,000 lb., the



Arrangement of Cardwell Duplex Draft Gear

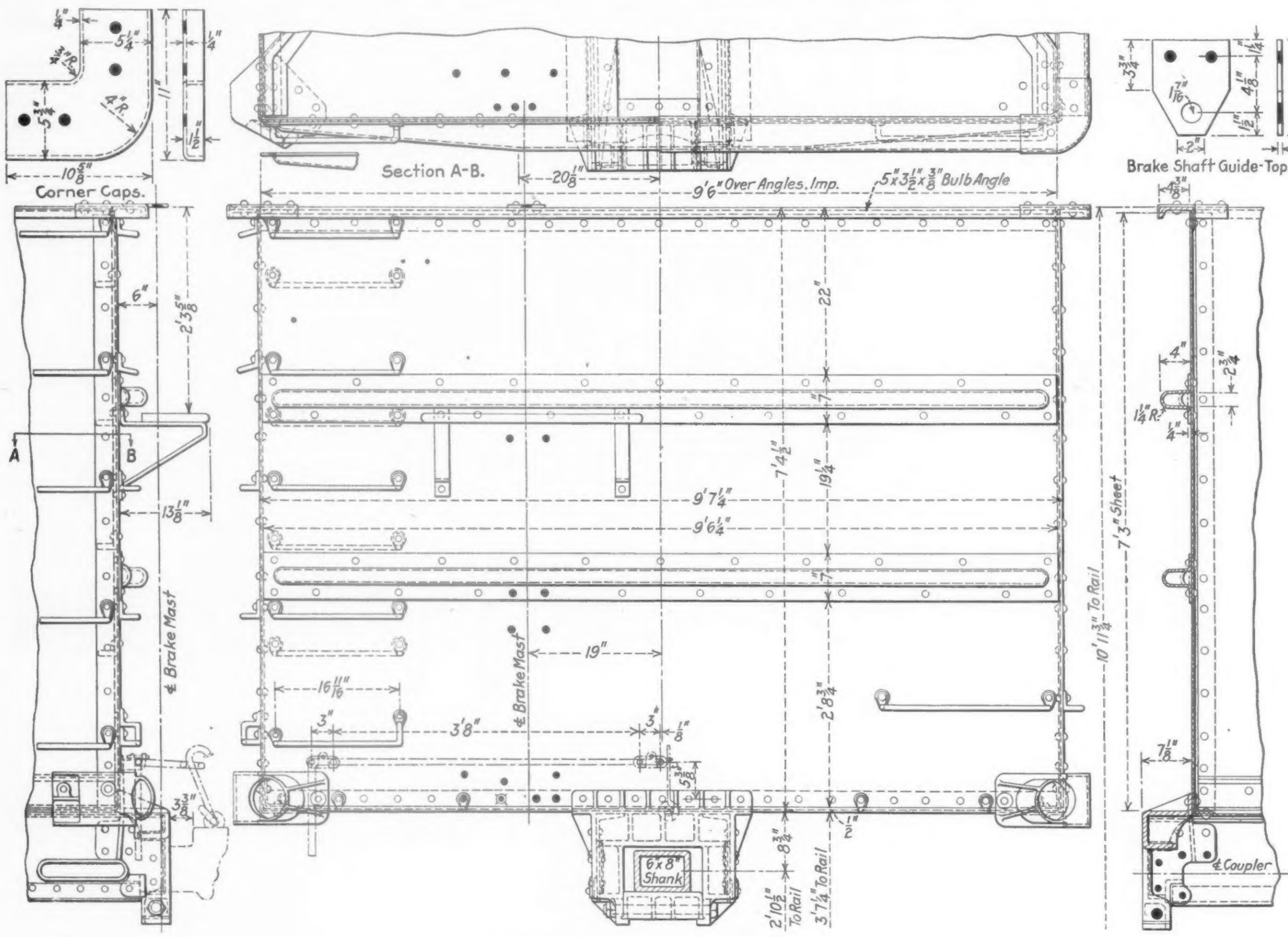
load which the car is designed to carry, both from the standpoint of strength and as to dimensions.

The size of the car, coupled with the fact that it is deeper at the center than at the end, gives it the general appearance of one of the modern quadruple hopper cars. However, it is not a hopper car, as it has no hoppers, drop doors or means of discharge other than from the top. It is to be operated solely on the lines of the Virginian and dumped only in car-dumping machines. These facts suggested the design finally adopted.

The sides, it will be noted, are entirely free from outside side stakes or other projections beyond the plane of the side sheets. The car presents a smooth, straight surface throughout the depth of the body at all points to engage the blocking and clamps in car dumpers, thus avoiding concentrated stresses on side stakes, top angles and other projections while the car is being dumped. This construction also admits of using practically all of the clearance width of the road for the inside or available loading width of the car and provides the required cubic capacity in a minimum length and height.

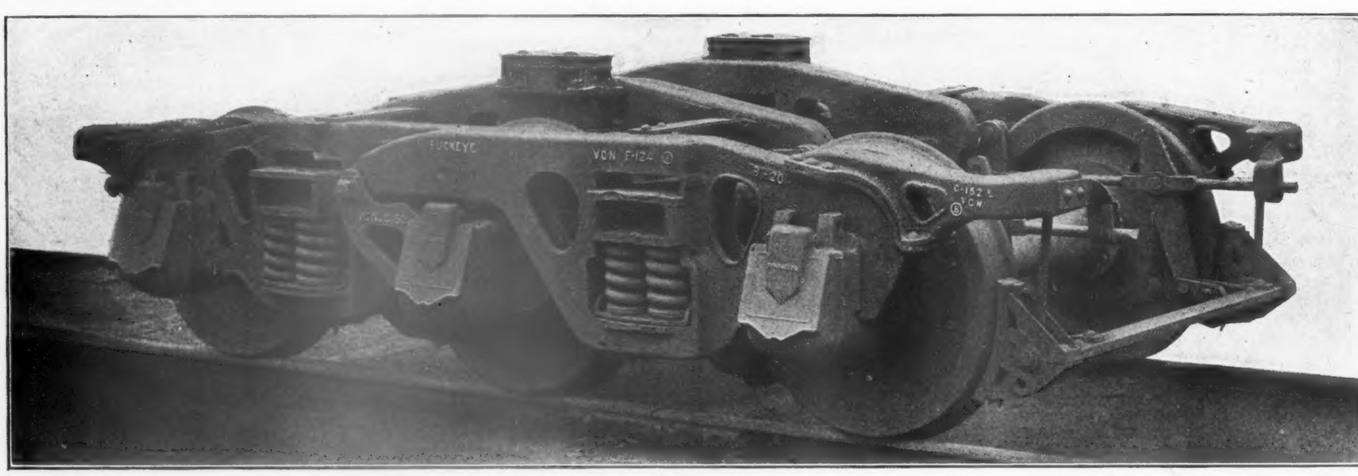
The sides are formed of ¼-in. plates sloped in near the

top at an angle of approximately 15 degrees and then flanged out, overlapping the horizontal leg of the top angle to which they are riveted. The top angles are standard 4 in. by 4 in. by ½ in. rolled angles with the vertical flange outside in the bottom the sides are reinforced by a 3½-in. by 3½-in. by ⅜-in. rolled angle, which also supports the floor. This angle extends to within approximately 2 ft. 4 in. from either end. At these points the plane of the side sheets is dropped



Details of the End of the Car Body

line with the plane of the side sheets. On the inside of the side construction 14 stakes are provided on each side and the connection between these stakes and the side top angle is effected through malleable iron castings, as is shown in back into the car to bring the ladders inside the clearance limits and also to afford these a certain amount of protection in car dumpers and elsewhere. The assembled side construction forms an efficient girder which will carry the entire

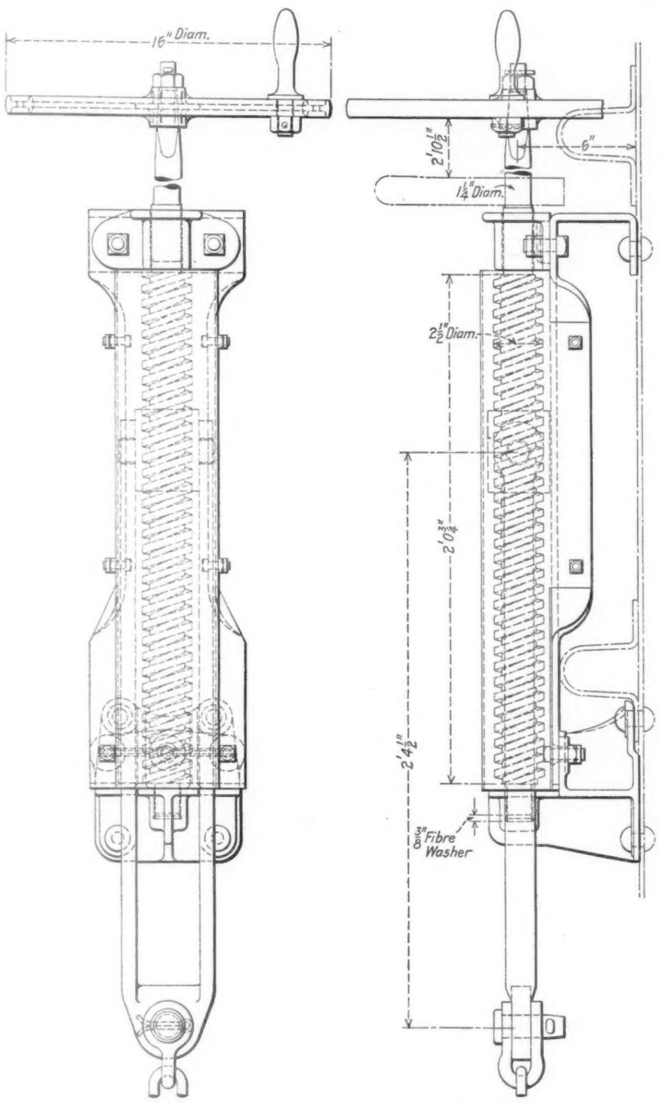


The Buckeye Six-Wheel Truck

the drawings of the car body. The side stakes consist of reinforced triangular gussets and 5-in. rolled bulb angles, all directly connected to bolsters, cross bearers and floor supports, all of which are located inside of the car body. Along weight of the lading as well as the dead weight of the car at a low fiber stress and leave the center sills to take care of the buffing stresses.

The center sills are made up of two 13-in. 37-lb. standard

rolled channels applied with the flanges toward each other and reinforced at the top by a cover plate and at the bottom by 4-in. by 3½-in. by ⅜-in. rolled angles. Five hundred cars are equipped with Westinghouse N-12-A draft gear and Lewis or Lamont trucks, being known as Class G-4 cars, while the remaining 500 cars have Cardwell duplex draft gear and Buckeye trucks. These are known as Class G-3 cars. On the Class G-4 cars the center sills are spaced 18½ in. apart and on the Class G-3 the standard 12⅞-in. spacing is employed. The center sills develop an effective buffing area of over 30 sq. in. and the ratio of stress to strain, figured according to A. R. A. practice, is below .05.



Details of the Screw Type Hand Brake

The ends are formed of ¼-in. plates reinforced at the top by a 5-in. by 3½-in. by ⅜-in. rolled bulb angle, intermediately by two pressed steel braces extending the full width of the car and at the bottom by the floor sheets, which are flanged up to engage the ends and are riveted thereto. The floor sheets are all ¼-in. plates and all floor supports, including bolsters and cross bearers, are of built-up construction.

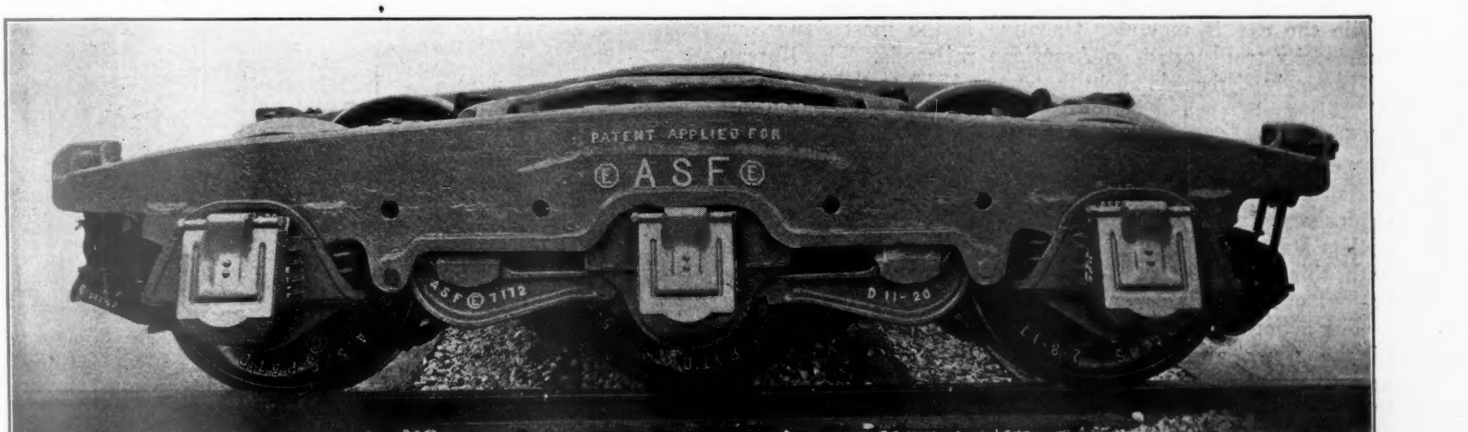
The trucks are of the six-wheel type with cast steel frames, two designs being used, as previously mentioned. They are equipped with A. R. A. standard 6-in. by 11-in. axles, 33-in. rolled steel wheels, Stucki side bearings and clasp brakes.

The Lamont Truck

The first application of the Lamont six-wheel truck, which has just been developed by the American Steel Foundries, has been made under ten of these cars. The outstanding features of this truck are its short wheel base of 8 ft. 3 in., the arrangement of the springs and equalizing system, and the three piece bolster which uniformly distributes the load over the four points of support.

The bolster is made up of a central or equalizing member and two cross bolsters. The central bolster carries the center plate and side bearings and at either end rests on the middle of one of the cross bolsters, the ends of which in turn are carried on the longitudinal equalizers under the side frames. The principal feature of the equalizing system is the location of the springs at the journal boxes instead of over the equalizer. The journal boxes are of special construction, in which seats are provided for coil springs on either side of each box, the truck frames resting directly on the springs of the end journal boxes. The springs at each of the middle journal boxes are spanned by a spring cap; on the middle of this cap bears an equalizer, from the ends of which are hung the inner ends of the main equalizers. The other ends of the latter are hung from the truck frames.

Westinghouse empty and load schedule KDE-4-10-16 brake equipment is used for the power brake and for braking the cars by hand, a special screw type of hand brake is provided, as the ordinary type would not be suitable for spotting these cars on dumpers and in handling them about the mines where, at points, it is necessary to drop them down steep grades after loading. The couplers are of a special design having A. R. A. type D heads and slots for connecting to



The First Application of the Lamont Truck Was Made on Ten of These Cars

draft gear with 2-in. by 6-in. forged keys and cast steel yokes.

The completed cars are 10 ft. 11¾ in. high from rail to top of sides. The Class G-3 cars weigh 78,800 lb., of which 41,600 lb. represents the weight of the body and 37,200 lb. the weight of the Buckeye trucks. The Class G-4 cars weigh 78,900 lb., the body weighing 43,200 lb. and the Lewis trucks 35,700 lb. These dead weights make the ratio of revenue earning load to total weight hauled 75.3 per cent.

Tank Car Outlets and Other Projections

Colonel B. W. Dunn, Chief Inspector of the Bureau of Explosives, having received many letters protesting against the recent prohibition of nipples or other attachments to bottom outlet valves of tank cars, has issued a statement calling attention to the dangers incident to the transportation of gasoline.

The tank car committee of the American Railway Association finds the tank car and the locomotive tender, of all railroad equipment, the most liable to derailment; and in the case of the tank car, the breakage of the outlet chamber almost invariably follows the derailment and adds greatly to the danger of further damage.

The bottom outlets of tank cars have always given more trouble in connection with leakages and fires than any other cause. It is contrary to elementary principles of safety to make a hole in the bottom of a tank containing thousands of gallons of a dangerous inflammable liquid, and depend upon any device to keep it closed. On English railroads a bottom valve is not allowed in any "tank waggon" carrying inflammable liquids of the first class. Furthermore, such liquids as gasoline are not transported in "tank waggons" of any type.

The Bureau of Explosives appreciates the difficulties. The desideratum is a car with valves which would not leak; but no valve has yet been placed in service which successfully accomplishes this result. The next best thing is to use a solid valve cap as a second defense against leakage at the bottom of the outlet chamber. If builders had made a serious effort years ago to make a really tight outlet, one might have been developed. It is hoped that some one of the experimental types now under service tests may prove satisfactory.

When extensions in the way of nipples and stop cocks are added to the outlet chamber the hazards are greatly increased. Valves extending below the bottom of the outlet chamber provide additional joints, each one of which is an additional possibility for leakage. These extensions are also liable to be struck and knocked off or ruptured by flying ballast or obstructions during transit. Consignees demanding these forget that the extensions increase the hazards while the car is moving. Gasoline is the most dangerous commodity transported on American railroads. The Bureau of Explosives' records show that from 1910 to the beginning of the present year, gasoline was responsible for 83 per cent of the deaths, 63 per cent of the personal injuries and over 49 per cent of the property damage occurring in the transportation of all classes of dangerous articles, exclusive of explosives. In the majority of the gasoline losses the bottom outlets started the trouble. So long as the railroads put up with this situation, just so long will improvement of the bottom outlet arrangement be delayed.

The action taken at the meeting of the tank car committee of the American Railway Association on June 4, 1920, against supplementary extensions, is believed to be a step in the right direction. It amended Section 7 of the Tank Car Specifications by adding sub-paragraph "c" providing that "No nipples, valves or other attachments, shall project below the bottom outlet cap except while car is being unloaded." This decision of the tank car committee was based principally upon the records of results in a large number of cases where this type of car was involved. The Bureau of Explosives heartily concurs in the action of the committee.

Effect on Cost of Repairs of Changes in the Percentage of Freight Cars at Home

In developing a method for arriving at allowances which should be made in the expenditures for maintenance of way and equipment in the application of test period amounts to guaranty period conditions in the settlement to be made between the railroads and the United States Government for the six months' guaranty period, following the return of the roads to private operation, a committee representing the railroads has made a study of the effect on the cost of maintenance of freight cars of variations in the proportions of home and foreign cars on the lines. The studies are based on information covering the test period received from 80 railroads owning 82 per cent of the freight car equipment of the country.

Change in Cost of Freight Car Repairs With Change in Per Cent of Cars at Home

The results of this study are shown graphically in the diagram, and the values from which the curves were plotted are given in the table. Starting with a cost of 100 per cent, or unity, for 100 per cent of owned cars at home, the cost increases at an accelerating rate as the per cent of owned cars on the home lines decreases. The cost shows an increase of 21.17 per cent when 50 per cent of owned cars are on home lines and with 25 per cent of the owned cars at home the cost of repairs is 45.56 per cent greater than the base figure. For 13 per cent owned cars at home, the smallest percentage covered by the actual observations, the cost of repairs is 61.21 per cent higher than the base figure, or over 33 per cent greater than when the normal proportion of half of the cars which the road owns are at home.

EFFECT ON COST OF REPAIRS OF CHANGES IN PERCENTAGE OF FREIGHT CARS AT HOME

Change in Cost of Freight Train Car Repairs Due to Change in Percentage of Owned Cars on Home Line

Column 1—Average per cent owned freight train cars on home line of total owned freight train cars.

Column 2—Per cent of cost for all owned cars at home.

Col. 1	Col. 2	Col. 1	Col. 2	Col. 1	Col. 2	Col. 1	Col. 2	Col. 1	Col. 2
*1	179.32	21	150.55	41	128.94	61	113.61	81	104.39
*2	177.73	22	149.30	42	128.02	62	113.04	82	104.05
*3	176.15	23	148.06	43	127.09	63	112.48	83	103.70
*4	174.56	24	146.90	44	126.17	64	111.91	84	103.36
*5	172.97	25	145.56	45	125.24	65	111.34	85	103.02
*6	171.46	26	144.46	46	124.43	66	110.81	86	102.76
*7	169.95	27	143.36	47	123.61	67	110.28	87	102.49
*8	168.43	28	142.27	48	122.80	68	109.76	88	102.23
*9	166.92	29	141.17	49	121.98	69	109.22	89	101.96
*10	165.41	30	140.07	50	121.17	70	108.70	90	101.70
*11	164.01	31	139.01	51	120.41	71	108.26	91	101.51
*12	162.61	32	137.95	52	119.66	72	107.83	92	101.32
13	161.21	33	136.90	53	118.90	73	107.39	93	101.14
14	159.81	34	135.84	54	118.15	74	106.96	94	100.95
15	158.41	35	134.78	55	117.39	75	106.52	*95	100.76
16	157.09	36	133.80	56	116.75	76	106.16	*96	100.61
17	155.77	37	132.82	57	116.11	77	105.80	*97	100.46
18	154.44	38	131.83	58	115.46	78	105.45	*98	100.34
19	153.12	39	130.85	59	114.82	79	105.69	*99	100.15
20	151.80	40	129.87	60	114.18	80	104.73	*100	100.00

*Readings from curve projected beyond observations.

Container Car in Express Service on N. Y. C. Lines

American Railway Express Company Operates Experimental Car Between New York and Chicago

THE container system of transporting materials has been given much attention in the past and considerable progress has been made in development work. These experiments have, however, been made only in freight service in an attempt to relieve the congestion of traffic due to delays in loading or unloading the present type of freight car, particularly when handling less-carload shipments. Many of the same difficulties and delays are also encountered in handling express matter and this has led to the application of the container idea to the railway express service.

A container car designed especially for express service has been placed in operation on the New York Central between New York and Chicago. This car left New York recently in an American Railway Express train and after delivering its cargo of merchandise for leading Chicago department stores at the South Water street terminal of the Michigan Central Railroad, was reloaded and made a return trip to New York.

New York Central Container Car Designed for Handling Express Matter, Equipped with Passenger Trucks and Buffers and with Air, Steam and Signal Line for Passenger Train Operation

A Nine-Section Express Car

The car is a nine-section express car, its sectional cargo space consisting of nine separate containers or steel boxes firmly secured on the car to prevent shifting during train movement. Each container is removable so that it may be transported by motor truck between stores or factories and the railroad.

This new equipment was built by The Merchants Despatch Transportation Company of East Rochester, N. Y. It consists of a modified low-side gondola car carrying nine containers which may be lifted on or off the car by means of a crane or other type of hoisting apparatus. The car is constructed along the lines of the New York Central standard 60 ft. baggage car and is mounted on two four-wheel trucks of the passenger type. It is equipped with passenger buffers and with air, steam, and signal line connections so that it may be operated in passenger train service. The underframe is of steel construction throughout having a deep center sill which is supplemented by the construction of the car sides. The superstructure consists of a low steel side framing—about 30 in. high—having side plates of steel which stiffen the car frame and also serve to prevent any sidewise movement of the containers. The sides are connected at each end of the car to a cast steel anti-telescoping end-frame which is approximately the same height and width as a passenger car, having much the same appearance as a blind-end baggage car.

The containers are designed so that they may readily be removed from the car and loaded upon automobile trucks. They are 9 ft. long by 6 ft. wide inside, have an inside clear height of 7 ft. 4 in. and a capacity of 6,000 lb. They are substantially built of structural steel and being entirely of metal will eliminate the losses due to damage from fire. A door is provided in one side of each container through which the material is loaded and the door then locked and sealed. The container is then placed upon the car where the side of the car which projects above the base of the door gives additional security to the contents as the door cannot be opened until the container is raised above the top of the side frame. This feature makes the pilfering of goods—now so prevalent—practically impossible. Besides the facility with which the container and its contents may be handled, this method of transportation is expected to eliminate much of the delay caused by the detailed billing and re-checking of small shipments.

On the initial trip of this express car, the handling of the loaded containers was accomplished with surprising speed. With no special station equipment—only a locomotive crane being available—the containers were transferred from motor trucks to their positions on the car in from 30 seconds to two minutes each. Under existing conditions, this nine-section express car could therefore be unloaded and reloaded ready to proceed within 40 minutes. No crew of handlers equipped with trucks could possibly equal this performance.

In addition to the nine-section steel container car now in passenger train express service, there are at the present time

under construction at the plant of the Merchants Despatch Transportation Company other container cars for use in freight train service. These cars, which are 46 ft. long, are provided with steel underframe, wooden sills and floors, and steel sides and ends about 24 inches high for holding the containers in place. The cars will be equipped with standard freight car trucks and will be in every way suited for regular freight train service. The containers now under construction for use with these cars in freight service are 15 ft. long, and three containers will be used on each car. They are constructed with steel sides, ends, roofs and floor frames, wooden floors and sheathing and doors in one end only.

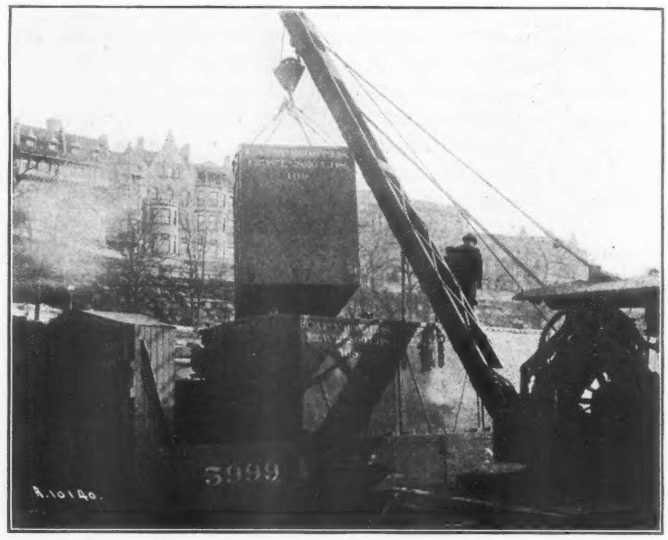
Other Container Cars Under Construction

It is expected that this container car system will be expanded by the New York Central to completely co-ordinate the steam railroad, the motor truck and the electric railway. If it proves to be successful in actual service it will bring about a new system of handling less-carload freight and express matter between large centers of population. The

Empty Container Showing Interior and Door Construction

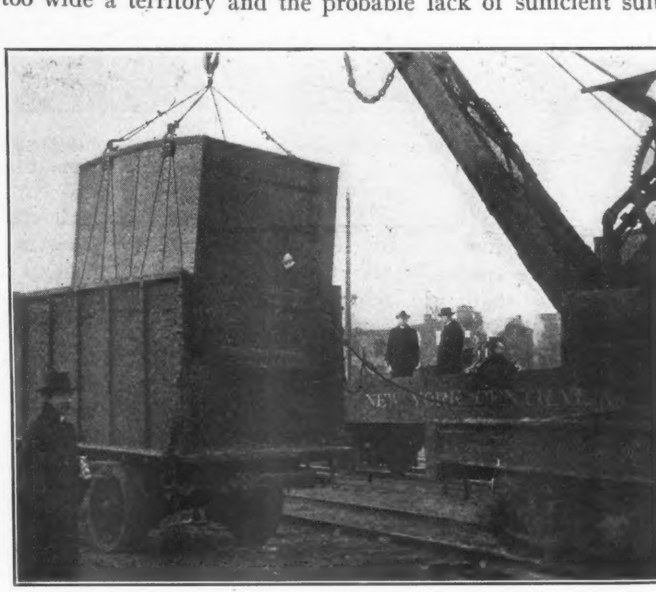
New York Central primarily seeks greater security for shipments in transit, the losses to the railroads through the theft and damage of goods having increased alarmingly in recent years—the aggregate annual loss and damage claims paid by American railroads in 1920 having been increased about 300 per cent since 1914. Several other points of improvement in service are expected from the container car system of transportation. This system provides that the portable containers shall be loaded and locked on the shippers' premises and then conveyed by motor truck and lifted aboard the car. At destination the locked container is carried by motor truck direct to the consignee. All of the intermediate handling and checking processes are done away with.

Another advantage of the new system which is expected to prove most valuable is greatly increased use of rolling stock in actual service. This is particularly important when traffic expands to its "peak" and the prime need is to shorten layovers of cars in yards and stations for loading and unloading, and to limit their idleness through misuse for storage purposes. With ample supplies of the removable containers, which in their several classes will be of uniform size and interchangeable, one carload of the containers may be removed and sent with their loads to consignees, and another set immediately hoisted to their places and the car be ready to proceed within a matter of minutes. The containers may remain on station platforms or on the premises of shippers for loading or unloading at convenience, without tying up rolling stock at points where track capacity is limited.



Locomotive Crane Placing a Loaded Container on the Car

One of the difficulties that will be encountered in the operation of this system will be the lack of adequate lifting apparatus on the premises of many shippers, which will necessitate the tie-up of a motor truck while the container is unloaded and reloaded. Other difficulties that must be overcome are: the possibility of scattering the containers over too wide a territory and the probable lack of sufficient suit-



A Loaded Container Being Lifted From the Motor Truck

able traffic in one direction. These objections to such a system are, however, vastly outweighed by the advantages.

The performance of this first car in express service will be followed closely and it is expected that in a future issue, the readers of the *Railway Mechanical Engineer* will be given some very interesting operating data.

Draft Gear Tests of the Railroad Administration

First of a Series of Articles Describing Investigations Conducted by the Inspection and Test Section

THE draft gear tests of the United States Railroad Administration were originally undertaken at the request of the Committee on Standards for Locomotives and Cars and the Central Advisory Purchasing Committee for the purpose of determining the relative merits of the several commercial gears in order that mechanical excellence and costs might be evaluated. The Inspection and Test Section, as a preliminary to any work, carefully studied all of the common methods of testing draft gears. Letters on the general subject were also addressed by the section to all of the draft gear manufacturers and to a large number of prominent mechanical officers of the roads, the replies to which showed a wide difference of opinion, not only as to the proper method of testing draft gears, but as to what performance should be expected from a gear.

A comparison of the many test reports submitted showed an entire inconsistency in results, supposedly obtained under similar conditions. It became evident that a test of all gears under exactly the same conditions, removed from any proprietary influence, was essential, and also that the tests should be conducted in such a manner as not only to determine the comparative value of the several gears, but to obtain all the exact information possible with respect to draft gear action, and to extend the study as far as possible toward the ultimate determination of the ideal draft gear. With such a program in view, the co-operation of the A. R. A. Committee on Draft Gears was felt to be desirable, and upon invitation from this section, this committee has taken an active part in the test work and in analyzing and compiling the results.

The present report covers in a rather extensive manner the action and comparative merits of the various gears when considered from the viewpoint of impact and buffing. The opportunity for the investigation of draft gears in train starting and similar operations has not developed as was hoped for, so that it is impossible at this time to present definite information in this latter respect.

The full investigation of draft gears should include not only the laboratory and impact tests of the present report, but also a wide range of train operation tests and service tests, from the results of which should be determined:

1. The minimum amount of movement necessary between cars for starting trains, and whether this movement may be free slack, as between coupler knuckles, or whether it should be resisted movement.
2. Whether the beginning of draft gear compression should be an easy movement or a stiff movement, and whether there should be an initial compression to prevent movement from slight shocks.
3. The effects of recoil and what amount of release force is desirable.
4. The desired capacity, travel and ultimate resistance of the gear, as well as the shape of the curve representing draft gear resistance for both buffing and train starting.
5. The coupler horn and coupler shank clearance.
6. The life, together with the rate of wear and loss in gear capacity attending it, that should be expected from an acceptable draft gear, as well as the setting of a measure, either in time, mileage, or loss of capacity, when a draft gear should be removed from the car and be repaired or scrapped.

Draft Gear Testing

The following discussion on the general subject of draft gear testing is given for the benefit of any who may be called upon to do similar work in the future.

It is important to have a full knowledge of the condition of each test gear before putting it into a test. Check measurements should be made, such as spring heights, barrel or housing dimensions, initial spring compression, initial friction compression, absolute free height, absolute friction height, and solid height, keeping a record of possible travel at any of the previously mentioned gear heights. By having such a record it will later be possible to check up the gear conditions and to know whether any loss in travel is due to set of springs, wear of friction members or deformation of parts of the gear. Depreciation in any of these respects should be reported in equivalent loss in coupler or gear travel.

It is important to protect the friction surfaces of test gears from any grease, rust or moisture. Even the handling of the friction faces with bare hands may leave enough grease or moisture on them to lower the gear capacity.

In testing draft gears, the gear should not be loaded beyond the solid point. Few gears will stand much service beyond their normal capacities, especially under the drop machine. The determination of the solid point, however, is often quite difficult. The static test is best suited to accurately fix the limit of normal gear closure. In tests of other characters, such as the drop test, the gear should be closed only to the travel determined from the static cards as the limit of normal gear action.

All gears, irrespective of construction, should be set up and restrained in a suitable testing frame, corresponding in dimensions to the draft gear pocket in the car. The frame should be so designed that the influence of its yield will be minimized. The gear should rest in the frame upon pieces of metal corresponding to the stop faces of the gear draft lugs or other stop member. A striking plate of the same size as the coupler butt should be placed on top of the gear for receiving the blow. This will develop whether or not the gear construction is substantial enough to receive the coupler butt forces in service. Where followers are regularly used with a gear, they should, for comparative purposes, be set up with the gear in the testing frame. In all respects service conditions should be simulated in the testing frame, as in no other manner will the weak or strong points of a gear be shown. It is more convenient to test gears such as the Miner, Westinghouse and similar types without a frame, but a frame is necessary for some other gears, such as the Cardwell, and in any impact testing the yield of the frame, no matter how carefully constructed, may slightly increase the results. It is therefore only fair that all gears should be tested under similar conditions.

It is a noticeable fact, however, that if a friction gear is brought for testing from a cold place into a warm room, the capacity will be low; and if brought from a warm room to a colder outside atmosphere, the capacity will be higher. This is due to the deposit of moisture on the colder metal, or the abstraction of moisture from the friction surfaces of the warmer metal, as the case may be. In general the humidity of the air is a decided factor in testing, and an instance is known of a depreciation of 20 per cent in a gear which could be explained in no other manner.

Another point of interest is that when a gear is to be given a static test without a frame, and the free height of the gear is greater as set up than the pocket length in the car, the gear should first be compressed to slightly below the pocket dimension and then released to the exact pocket length. The compression test should then start from this released point.

In impact testing, where the load passing through the gear to the supporting device is measured or compared, the gear should never be tested beyond the closing point. This rule applies particularly to rivet shearing tests and car-impact tests. It should be remembered that after a gear goes solid its normal functioning ceases, and further testing is only of the gear housings or barrel. Hence in over-solid testing the greater deformation of a weaker gear barrel offers additional protection to the rivets for the time being, and also offers more yield in the car tests. Any considerable repetition of such over-solid blows would, however, shortly destroy the gear. On the other hand, a sturdy gear will usually shear the rivets at the first over-solid blow and will similarly produce a sudden change in car velocity, but the sturdy gear will not be so quickly destroyed. For a full knowledge of the functioning of a gear it is necessary to know only its capacity up to the point of closure and the character of its action within that capacity. Any yield or cushioning beyond the solid point is due to deformation or spring of the heads or barrel, and is obtained only at the expense of strength and life of the gear.

The suggestion is frequently made that all gears be tested to determine the point where a force of say 500,000 lb. is set up in the sills. On the face this would appear to be entirely reasonable and a proper test for the grading of gears. But for the same reasons as before, a premium would be placed upon a weak gear construction. Furthermore, it is a fundamental principle of mechanics that there can be no force set up in any structure greater than the resistance offered by the structure. It therefore follows that if a gear were constructed with an ultimate strength value of 400,000 lb. it would be physically impossible to apply 500,000 lb. through it to the car. Hence, the only over-solid draft gear tests that should be made are those that will discover the weakness of a gear rather than credit it with false merit. The destruction and endurance tests are the only over-solid draft gear tests known that will correctly rate the gears in this respect.

Another practice from which wrong conclusions are often drawn is that of testing gears against sills of different sizes and conditions. It is not fair to set up one gear on heavy channels and another on light channels, as again, the force developed will depend upon the yield and the resistance offered by the channels. Thus if a test were made upon 20-lb. channels it would be unreasonable to expect as high a force as upon 30 lb. or 40 lb. channels, for not only is there a greater yield of the channel, but the elastic limit of the material in the lighter channels might be reached and passed, which would preclude the possibility of reaching as high a force as might be shown in the heavier channels. In other words, it is impossible to put more load into the light channels than they will stand, as the force is limited by the resistance of the structure supporting the gear.

Test Program

The following general program was decided upon for the present tests as offering the best means of investigating the comparative action of the gears:

9,000 lb. Drop Tests—Solid Anvil.
- Closing gears by drops of 1 in. increments.
- Recoil tests.
- Investigation of influence of foreign material on friction surfaces.
- Investigation of rivet shearing tests.
- Destructive tests.

Static Tests.
- Closing gears at a rate of 1/8 in. per minute.
- Closing gears at a rate of 3/4 in. per minute.
- Closing gears at a rate of 3 in. per minute.

Car Impact Tests.
- Calibrated gear in one car only, solid buffer in another car.
- Calibrated gears in both cars.

In general three each of 18 different types of draft gears are embraced in the tests. The table of Fig. 1 has been prepared to identify the gears and to give other data of prime interest in connection with them. Fifty-nine gears in all were used because of gear failures developing during the progress of the various tests.

Description of Gears

In the report as presented, the gears used are described at some length. Since practically all of the types tested are in common use, these details will be omitted and the description will be confined principally to those features which differ from the usual practice.

WESTINGHOUSE TYPE D-3.—This is the well-known friction draft gear of the Westinghouse Air Brake Company. It has a nominal travel in the car of 2 7/16 in., the first 5/8 in. of which is spring travel, the remainder being friction travel.

Test Gear Number	Make and Type of Gear	Nominal Travel	Nominal Length	Average Weight One Gear	Number of Std. Followers Req'd. per Car	Comparative Weight per Car
	①	②	③	④	⑤	⑥
1, 2, 3	Westinghouse D-3	2 7/16"	20 1/8	200#	4	684#
4, 5, 6, 7, 8	Westinghouse NA-1	3"	22 5/8"	368#	2	878#
9, 10, 11, 12	Sessions K	2 1/16"	20 1/8"	252#	4	788#
13, 14, 15	Sessions Jumbo	3"	24 5/8"	433#	0	866#
16, 17, 18	Cardwell G-25-A	2 3/4"	24 5/8"	440#	0	880#
19, 20, 21	Cardwell G-18-A	3 3/16"	24 5/8"	440#	0	880#
22, 23, 24	Miner A-18-S	2 1/2"	22 5/8"	346#	2	834#
25, 26, 27	Miner A-2-S	2 1/2"	20 1/8"	207#	4	698#
28, 29, 30	National H-1	2 1/2"	24 5/8"	428#	0	856#
31, 32, 33	National M-1	2 1/2"	24 5/8"	372#	0	744#
34, 35, 36	National M-4	2 1/2"	24 5/8"	322#	0	644#
37, 38, 39	Murray H-25	2 3/4"	24 5/8"	376#	0	752#
40, 41, 42	Gould 175	2 1/2"	22 5/8"	337#	2	816#
43, 44, 45, 46, 47	Bradford K	2 1/2"	24 5/8"	386#	0	772#
48, 49, 50	Waugh Plate	2 1/4"	24 5/8"	420#	0	360#
51, 52, 53	Christy	2 1/2"	22 5/8"	442#	2	1026#
54, 55, 56	Harvey 2-8"x8" Spgs.	1 7/8"	7 7/8"	104#	8-1 1/2" Followers	670#
57, 58, 59	Coil Springs 2-8x8-Class G	1 7/8"	7 7/8"	110#	8-1 1/2" Followers	682#

Fig. 1—Gears Included in the Test Program

WESTINGHOUSE TYPE NA-1:—This is a new gear recently introduced by the Westinghouse Air Brake Company. A description of its construction will be found in the Railway Age, Daily Edition for June 14, 1920, page 1785. The nominal travel of the gear in service is 3 in.

SESSIONS TYPE K:—This is the type of gear manufactured by the Standard Coupler Company and used on 50,000 of the United States Railroad Administration cars. The gear has a nominal travel of 2 1/16 in., the first 1/8 in. of which is spring travel and the remainder friction travel.

SESSIONS JUMBO:—This is a heavier gear of 3 in. nominal travel recently developed by the Standard Coupler Company and is similar to the Type K gear.

CARDWELL TYPE G-25-A:—This is the regular pattern

of the Union Draft Gear Company's gear slightly modified to give a nominal travel of 2¾ in.

CARDWELL TYPE G-18-A:—This is the regular Cardwell gear of the Union Draft Gear Company with 3 3/16 in. nominal travel.

MINER TYPE A-18-S:—This is a slightly modified arrangement of the well-known A-18 gear of W. H. Miner and is the design applied to United States Railroad Administration locomotive tenders. The gear has a nominal travel of 2½ in.

MINER TYPE A-2-S:—This is a slightly modified arrangement of the A-2 gear of W. H. Miner, the nominal travel being 2½ in.

NATIONAL TYPE H-1:—This is a new gear of 2½ in. nominal travel, manufactured by the National Malleable Castings Company. A central friction column with four ways in it is cast integral with one follower of the gear. In these ways are four friction segments, or shoes. The other, or movable follower, is arranged to wedge these shoes inwardly into the ways of the column and, as the gear is closed, the longitudinal movement of the shoes is resisted by a single coil friction spring that surrounds the friction column below the wedges. Four independent corner posts of 1⅝ in. diameter steel are provided to receive the blow when the gear goes solid, so that this force is received on entirely different metal. An independent release spring surrounds each of these corner posts. The gear is held to any desired length and as a self-contained unit by means of two ¾ in. rods.

The friction members of this gear are made of electric steel, hardened. The corner posts are of tempered knuckle-pin steel.

NATIONAL TYPE M-1:—This gear is similar in construction to the National Type H-1, the most notable difference being that but two release springs are used instead of four as in the H-1 gear. Otherwise the same description serves for both. The nominal gear travel is 2½ in.

NATIONAL TYPE M-4:—This gear is of the same general construction as the two preceding National gears, but has three flutes in the center column with three friction shoes, and has no independent release spring. Otherwise, the design is the same as for the other National gears. The nominal travel is 2½ in.

MURRAY TYPE H-25:—This gear is of the regular Murray pattern without wear blocks as manufactured by the Keyoke Railway Equipment Company, but was specially designed to give a nominal travel of 2¾ in. for use on Railroad Administration cars.

GOULD TYPE 175:—This is the original Gould friction draft gear, manufactured by the Gould Coupler Company. It has single angle friction wedges pressed outwardly against the friction faces of the barrel by two sets of half-elliptic springs. It has a nominal travel of 2½ in.

BRADFORD TYPE K:—This gear is of the rocker type and is manufactured by the Bradford Draft Gear Company. The nominal travel is 2½ in.

WAUGH PLATE TYPE:—This is the well-known plate gear of the Waugh Draft Gear Company. As included in the test, each gear was made up of four sets of plates in series, each set consisting of 15 steel plates, ¼ in. by 6 in. by 11⅞ in. The nominal travel is 2¼ in.

CHRISTY GEAR:—This gear, when tested, was under development by the American Car Roof Company. It has since been taken over by the Standard Forgings Company and, in a modified form, is now known as the Stanforge friction draft gear. A description of the gear in its present form can be found in the Railway Age, Daily Edition for June 14, 1920, page 1784. The nominal travel is 2½ in.

HARVEY FRICTION SPRINGS:—These are the regular interwound Harvey friction springs as manufactured by the Frost Railway Supply Company. Each gear, as included in the test, consisted of two of these springs set in twin fashion, side by side. The nominal travel was 1⅞ in.

A. R. A. CLASS G. SPRINGS:—These are the regular A. R. A. draft springs of 8 in. diameter and 7⅞ in. high.

Selection and Condition of Test Gears

At the beginning of these tests the various manufacturers were asked to furnish gears for test purposes, so that the gears as tested were in each instance procured directly from the proprietor, with full knowledge on his part that they were for test purposes. Whether or not gears of average manufacture were furnished must be decided from previous or additional experience with the several gears and from a knowledge of the manufacturing practices of the concerns. Unless a definite statement to the contrary appears in this report it is to be understood that gear conditions and performances as developed during the tests are in accordance with what is believed to be average conditions.

Immediately upon receipt of a test gear it was given a test number and then taken apart. The parts were marked, and measured for comparison with the manufacturer's drawings and for later comparative tests measurements. The gears were reassembled with the parts in their original positions and were given a definite amount of preliminary drop test work to condition them for the regular tests.

WESTINGHOUSE D-3:—These gears as received were in good average condition and conformed very closely to the dimensions given on the manufacturer's drawings. The results obtained in the test agreed very well with the results obtained in other tests of the same gear.

WESTINGHOUSE NA-1:—The gears as received appeared to be in average condition and the results of the test in general are believed to be representative of the action of the average product.

SESSIONS K:—The gears as received represented average workmanship and condition and the results of the test in general are comparable with previous tests of the same gear.

SESSIONS JUMBO:—These gears as received represented average workmanship and condition. The results of the test are believed to be representative of the commercial gear.

CARDWELL G-25-A:—These gears as received were in average condition as to workmanship. The springs furnished for the test gears were of excessive length, the average free length being 10 1/16 in., whereas the drawing dimension is 9½ in. With all the parts properly assembled on the spring rod, the springs from the drawings should be under 3/16 in. compression, while with the gears as furnished, the springs were under ⅝ in. compression. The average drop test results obtained from these gears are greater by slightly more than 4 in., than the average results obtained in routine acceptance tests of the same gear. The lowest capacity gear of this type in the present test is more than 3 in. greater than the highest capacity gear of the same type in the Railroad Administration's acceptance test. It is, therefore, believed that the results obtained from these test gears are not representative of what may be expected from the regular product as furnished commercially.

CARDWELL G-18-A:—These gears were received in average condition as to workmanship and the parts conformed more closely to the drawings than in the case of the G-25-A, although they averaged above the drawings. The individual variations, however, would probably be accepted as within manufacturing limits. The averages are believed to more nearly represent the true value of the commercial gear than those obtained from the other Cardwell type.

MINER A-18-S:—These gears as received were in good average condition as to workmanship and material. The results obtained are in harmony with those of other tests and the gears are believed to be representative of the commercial product.

MINER A-2-S:—The condition of these gears as received correspond with that of the Miner A-18-S and the test gears are believed to be representative of the commercial gear.

National H-1:—These gears conform closely to the drawing dimensions. The results obtained are comparable with results obtained in other tests of this gear and are believed to be representative of the gears as furnished commercially.

National M-1 and M-4:—The condition of these gears corresponded with that of the other National gears and is believed to be representative of the commercial product.

Murray H-25:—These gears as received had probably been given more conditioning than any other gears in the test, yet the results are not believed to have been influenced especially as they are just slightly below the average routine acceptance test of the same type for Railroad Administration cars.

Gould 175:—These gears conformed with drawings and appeared in good average condition except for a coating of grease which was found in the interior. The manufacturer disclaimed all knowledge of this and the parts were cleaned and the gears placed in a satisfactory condition. The results of the test are believed to be representative of the action of the commercial product.

Bradford K:—The undeveloped state of this gear makes it impossible to compare the test gear with the commercial product. It is felt that avoidable defects in workmanship and design are responsible, at least in part, for the breakage of gear parts noted later in the report.

Christy Gear:—As this gear was undeveloped and had never been furnished commercially, comparisons are impossible. The test gears had all of the friction surfaces machined, although it is understood that the gears were designed to be furnished regularly of rough castings. Some of the parts did not correspond to the dimensions on the drawings and the gear travel was 3/8 in. less than the drawings called for.

Harvey Friction Springs:—The spring group constituting these gears conforms reasonably closely to the drawing dimensions and the results of the test are believed to be representative of the commercial product.

A. R. A. Class G Springs:—The springs used in this test were of ordinary carbon steel oil tempered, drawn from regular railroad stock conforming to A. R. A. specifications.

DRAFT GEAR TESTS OF THE RAILROAD ADMINISTRATION

			Actual results from test gears						Average results to be expected from commercial gears				
				9,000 lb. weight					9,000 lb. weight				
Make and type of gear	Nominal travel, in.	Test gear number	Travel obtained, in.	Free fall to close gear, in.	Total fall to close gear, in.	Recoil above closing point, in.	Work done, ft. lb.	Work absorbed, ft. lb.	Total fall to close gear, in.	Recoil above closing point, in.	Work done, ft. lb.	Work absorbed, ft. lb.	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Westinghouse D-3	2 7/16	1	2.50	16	18.50	3.70	13,875	11,100	19.8	3.8	14,850	12,000	
		2	2.50	17	19.50	3.75	14,625	11,813					
		3	2.50	19	21.50	3.83	16,125	13,253					
Westinghouse NA-1	3	4	3.00	25	28.00	....	21,000	......	26.0	3.4	18,750	16,200	
		5	3.00	27	30.00	....	22,500	......					
		6	3.06	24	27.06	3.52	20,295	17,655					
		7	3.00	23	26.00	3.50	19,500	16,875					
		8	3.00	22	25.00	3.27	15,000	12,548					
Sessions K	2 1/16	9	2.00	19	21.00	....	15,750	......	18.8	4.3	14,100	10,875	
		10	2.17	16	18.17	3.78	13,628	10,793					
		11	2.06	18	20.06	4.43	15,045	11,723					
		12	2.06	16	18.06	3.92	13,545	10,605					
Sessions Jumbo	3	13	3.10	23	26.10	5.03	19,575	15,803	28.1	5.2	21,075	17,175	
		14	3.06	24	27.06	5.06	20,295	16,500					
		15	3.00	28	31.00	6.44	23,250	18,420					
Cardwell G-25-A	2¾	16	2.75	19	21.75	3.61	16,313	13,605	*18.9	2.8	14,175	12,075	*See text.
		17	2.75	18	20.75	2.92	15,563	13,373					
		18	2.75	18	20.75	3.12	15,563	13,223					
Cardwell G-18-A	3 3/16	19	3.25	19	20.25	1.82	15,188	13,823	19.6	1.5	14,800	13,575	
		20	3.29	15	18.29	1.00	13,718	12,968					
		21	3.25	17	20.25	1.54	15,188	14,033					
Miner A-18-S	2½	22	2.51	15	17.51	4.18	13,133	9,998	19.9	4.6	14,925	11,475	
		23	2.52	17	19.52	4.53	14,640	11,243					
		24	2.53	20	22.53	4.87	16,898	13,245					
Miner A-2-S	2½	25	2.55	11	13.55	3.83	10,163	7,290	13.2	3.8	9,900	7,050	
		26	2.53	11	13.53	3.82	10,148	7,283					
		27	2.50	10	12.50	3.79	9,375	6,533					
National H-1	2½	28	2.53	29	31.53	4.61	23,648	20,190	31.2	4.6	23,400	19,950	
		29	2.50	30	32.50	4.80	24,375	20,775					
		30	2.50	27	29.50	3.97	22,125	19,148					
National M-1	2½	31	2.52	16	18.52	3.14	13,890	11,535	19.2	3.4	14,400	11,850	
		32	2.53	16	18.53	3.22	13,898	11,483					
		33	2.53	18	20.53	3.61	15,398	12,690					
National M-4	2½	34	2.54	17	19.54	2.13	14,655	13,058	21.5	2.4	16,125	14,325	
		35	2.46	21	23.46	4.44	17,595	14,265					
		36	2.53	19	21.53	2.32	16,148	14,408					
Murray H-25	2¾	37	2.65	15	17.65	3.68	13,238	10,478	17.0	3.3	12,750	10,275	
		38	2.47	14	16.47	3.41	12,323	9,795					
		39	2.81	14	16.81	3.20	12,608	10,208					
Gould 175	2½	40	2.38	16	18.38	7.68	13,785	8,025	18.1	7.1	13,575	8,250	*Gould gear No. 41 was 1/16 in. shorter than the pocket length.
		41	*2.44	15	17.44	6.94	13,080	7,875					
		42	2.50	16	18.50	7.29	13,875	8,408					
Bradford K	2½	43	2.38	Failed	.....	....	......	......	10.8	5.3	8,100	4,125	
		44	2.44	Failed	.....	....	......	......					
		45	2.45	9	11.45	5.41	8,588	4,530					
		46	2.44	6	8.44	5.19	6,330	2,438					
		47	2.44	10	12.44	5.87	9,330	6,242					
Waugh Plate	2¼	48	2.17	12	14.17	8.04	10,628	4,598	13.9	7.6	10,425	4,725	
		49	2.25	11	13.25	7.25	9,938	4,500					
		50	2,25	12	14.25	8.22	10,688	4,523					
Christy	2½	51*	2.32	12	14.32	3.38	10,740	8,228	19.6	5.1	14,700	10,875	*Christy gear No. 51 was .22 in. shorter than the pocket length. Gear No. 52 was .38 in. shorter than the pocket length and Gear No. 53 was 3/16 in. shorter than the pocket length.
		52*	2.21	16	18.21	4.96	13,658	9,938					
		53	2.28	24	26.28	5.87	19,710	15,308					
Harvey 2-8 by 8 in. springs	1⅞	54	1.88	6	7.88	3.84	5,910	3,130	9.5	4.2	7,025	3,975	
		55	1.76	9	10.76	4.51	8,070	4,688					
		56	1.83	8	9.83	4.22	7,373	4,208					
Coil springs 2-8 by 8 in., Class G	1⅞	57	1.83	4	5.83	4.16	4,373	1,253	5.8	4.1	4,350	1,275	
		58	1.70	4	5.70	4.08	4,275	1,215					
		59	1.71	4	5.71	4.11	4,283	1,200					

Table 1—Comparative Performance of Gears in Shop Tests

Application of Limit Gages and Progressive Sizes in Railway Machine Shops*

BY COL. H. E. O'BRIEN

Assistant Mechanical Engineer, Lancashire & Yorkshire, Horwich, England

The adoption of graduated sizes of pins and holes and the bushing of holes subject to wear are two valuable methods of effecting economies.

The parts to be handled in the machine shop usually associated with "General Repairs" are—motion, valves and cab details.

Motion

The motion is dismantled in the erecting shop, examined, and results of examination posted on to the machine shop, giving particulars of new parts required, which are replaced from a stock which is maintained and based upon past experience.

The parts requiring repair are dealt with in the following manner:

Motion Pins (*Limit Gage*)—The limit gage system on motion is on the pin basis (owing to push and running fits being on one pin of one diameter). Tolerance on motion pins is 0.0005 in., the high diameter being the nominal diameter, the low diameter being the nominal diameter minus tolerance.

The motion pins are manufactured in nine different sizes, the first five varying 0.005 in. each and the remaining four vary 0.010 in. each, and each size is identified by a letter as follows:

	J	K	L	M	N	P	Q	R	S
High	2"	2.005	2.01	2.015	2.02	2.03	2.040	2.05	2.06
Low	1.9995	2.0045	2.0095	2.0145	2.0195	2.0295	2.0395	2.0495	2.0595

The pins are turned on automatics with an allowance of 0.010 in. to 0.015 in. for grinding after case hardening.

Hollow Motion Pins.—When these pins are worn below minimum size they are annealed and expanded by means of a press and mandrils: these mandrils run in sizes from No. 1 to No. 9, each varying in diameter 0.005 in. They are then rehardened and ground to size required. A substantial economy has been effected by this means.

Holes.—All rods are bushed with case-hardened bushes in rapidly wearing holes, and when worn the bush is pressed out and the new one inserted and ground to diameter required, which is governed by the size of hole in which the pin is fixed.

Limits.—The minimum variation allowed between pin and hole is that demanded for running fits, i. e., 0.0025 in. The maximum variation is 0.005 in., thus giving a manufacturing tolerance of 0.0025 in.

Reversing Shaft.—The journals of the reversing shafts wear slightly, and when worn oval to the extent of 0.010 in. they are turned up in lathe to graduated sizes, each varying 0.015 in., and when worn to the minimum diameter a sleeve bush is shrunk on and returned to standard size. Standard size of journal is 5 in., the minimum diameter is 4¼ in.

Reversing Shaft Carrier Bracket.—The bracket is bored out to allow for the fitting in of a cast iron sleeve bush; this diameter remains constant. The internal diameter of these bushes is machined to graduated sizes to suit the shaft journals. Worn bushes are re-bored to the nearest graduated size.

Radius Links.—These links wear mostly in the centre owing to the notching up when running; this necessitates them being ground parallel, and the radius blocks fitted to suit.

Radius Blocks.—Radius blocks are machined to four sizes, varying 0.015 in. each. After the blocks are fitted in the links a special fixture is used to mark the blocks while in position in the shaft, which ensures the holes being in line with the center of the shaft.

CHART SIZES OF RUNNING AND PUSH FITS

Running Fits

	J	K	L	M	N	P	Q	R	S
High	2.0045	2.0095	2.0145	2.0195	2.0245	2.0345	2.0445	2.0545	2.0645
Low	2.0025	2.0075	2.0125	2.0175	2.0225	2.0325	2.0425	2.0525	2.0625

Push Fits

	J	K	L	M	N	P	Q	R	S
High	2.0005	2.0055	2.0105	2.0155	2.0205	2.0305	2.0405	2.0505	2.0605
Low	2"	2.005	2.010	2.015	2.020	2.030	2.040	2.050	2.060

Reversing Screws.—The reversing screws are made in two

*Taken from a paper on Management of a Locomotive Repair Shop, read before the Institution of Locomotive Engineers, England.

The Foreman and His Training

The foreman directs the efforts of a group of workers.

He is ordinarily selected from the ranks because of his reputation as a master workman; in that capacity, however, he has had little, if any, training or experience in managing other workers.

Obviously the prime responsibility of a foreman is to understand human nature and direct human beings—a very different sort of task from handling tools or operating machines.

What sort of training should a foreman receive before he enters upon his new task? Who will be responsible if he fails to make good? What do you think about it?

sizes, standard 2-in. diameter, and a 1/16-in. above. When these are worn thin on the thread they are scrapped.

Reversing Screw Nuts.—These are also made in two sides, standard and a 1/16-in. above. The reason for this is, when the standard nut has worn thin on the thread they are machined out a 1/16-in. larger in diameter, thus giving the nut another life.

Piston Rods.—Piston rods wear smaller in diameter at the middle than the ends, due to the friction of the packing. This necessitates them being ground to bring the rod parallel the whole of its length. They are ground in five graduated sizes, each varying 0.0312-in., standard size being 3-in. diameter, minimum diameter 2⅝ in. After the grinding operation the rod is then dealt with on the bench to have the crosshead and cotter fitted. Occasionally the crosshead has expanded leaving no cotter draw; in that case a crosshead is taken from stock and fitted, leaving a ⅛-in. draw. The old crosshead is placed in stock, and when new rods are being turned these crossheads are despatched to the lathe and the rods turned on cone to suit, thus getting the crosshead into service again.

Crosshead Gudgeon Pins (Effect).—Gudgeon pins are examined, and if worn more than 0.0312-in. on the little end or slide block bearing, they are renewed. These are made in two sizes on the slide block bearing, standard, and 1/16-in. above to give the slide block another life. They are manufactured on the automatics, case hardened and ground.

Piston Head.—The piston head, if found to have a clearance in the cylinder bore of 3/16-in., is condemned for that particular engine. Should the diameter of the head be over standard size, it is placed in stock and machined to suit the cylinder nearest to its diameter. The bore and cone portion for the piston rod bearing remains constant in all cases and is therefore interchangeable. Clearance allowed between cylinder bore and piston head for new or re-bored cylinder is 0.015-in.

Slide Blocks.—Slide blocks wear very slightly in the gudgeon pin hole; in cases where the wear exceeds 0.010-in. they are re-bored to 1/16-in. above standard size. This is sufficient to wear the block and flange to their minimum thickness.

Slide Valve Spindles.—The flat valve type of spindle, when in for repairs, is generally found to have expanded at the buckle, and if this expansion exceeds 0.015-in. above standard, it is sent to the smithy for closing, and there machined up to standard in the buckle. Should the spindle have worn below the minimum diameter a new end is welded on to the buckle and machined to the standard diameter.

The standard diameter of the spindle is 2⅛ in. As the spindle wears more in the center than at the end, due to the friction of the packing, this necessitates it being ground to bring the rod parallel the whole of its length.

They are ground to nine graduated sizes, varying 0.015-in. from 2⅛-in. diameter to 2-in.

Valve Spindle Crosshead.—The same remarks apply to fitting of crosshead to spindle as in the piston rod.

Valve Spindle and Piston Packing.—Packings are manufactured in graduated sizes in conformity with piston rod sizes.

Cab Details.—The injectors are stripped of all cones and plugs; scale removed from body and cones. Valve seatings and cones are re-faced and adjusted.

Steam Valve and Tappet Valve Seatings.—Due to the constant wear and repeated cuttings of the seatings, they rapidly become worn out. In order to increase the life of the body it is bored out and a bush fitted as a renewable seat.

Pipe Ends.—Occasionally the thread on pipe ends becomes stripped; these are restored to standard by turning the ends down and sweating on a sleeve bush, afterwards re-cutting the thread. After injectors are repaired they are tested for efficiency in lift and delivery.

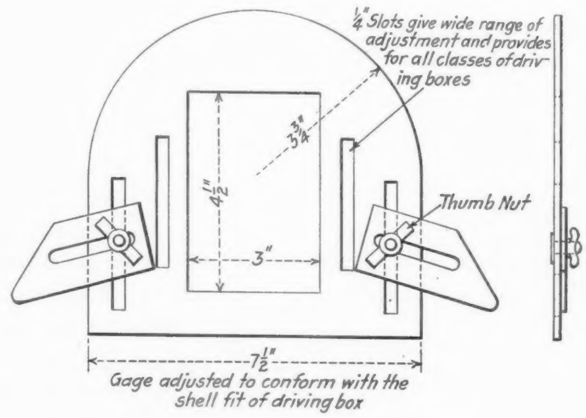
Ejectors.—The ejector is stripped of all plugs and cones, thoroughly cleaned and examined, and cones that have been cut due to action of the steam are re-turned and adjusted. In all wearing parts renewable seatings are fitted wherever possible. The disc plate requires turning up and facing to the driver's application handle. All glass gage cocks, lubricator cocks, etc., are stripped, examined and new plugs fitted where required. In cases of taper plugs they are ground only. Parallel plugs are ground and asbestos packed.

Driving Box Gage

BY A. W. C.

It is highly important that the crown brass of a driving box should be a good tight fit in the box, and this requires that the brass properly bears on the small angular surfaces as well as on the curved surface or back of the shell. If these requirements are not met, the brass will very easily work loose and become a source of trouble and annoyance. When an old brass has been removed, it is a rather difficult matter to measure the small angular surfaces, and their distance from the crown of the box, and then lay out these measurements on the shell. After being some years in service and having had various repairs made to them, driving boxes vary considerably, so that each brass must be made to fit its particular box, and the edges are not planed to any standard dimensions.

An expedient commonly resorted to in many repair shops



Efficient Form of Driving Box Gage

and roundhouses, is to place the brass on end on the box, in a position as near as possible to that which it will occupy in the box; that is, with the back of the brass in line with the crown surface of the box. The outlines of the angular surfaces are then scribed on the brass, which is planed to these lines, and pressed into the box with somewhat doubtful results. A simple, adjustable gage, as illustrated, can be made easily and used for accurately transferring the outlines of the angular surfaces on the box to the brass.

The gage is made of ⅛ in. sheet steel to the dimensions shown. The two wings or blades are attached to the body of the gage by ¼ in. carriage bolts and wing nuts. In use, the curved portion of the gage is placed against the crown of the driving box, and the blades are adjusted to bear on the angular surfaces in the box, being secured in that position by tightening the thumb nuts. The gage is then placed on the end of the brass, with the curved portion flush with the back of the brass. The outlines of the blades are scribed on the brass, thus faithfully reproducing the dimensions of the driving box brass fit. It is obvious that this saves handling the heavy driving boxes and brasses now in use and affords a far better method for getting a good fit.

Notes on General Shop Practice at Du Bois

Production Is Increased and Unit Costs Decreased By Using Present Equipment to the Best Advantage

BY GEORGE W. ARMSTRONG

MANY interesting and effective methods have been developed at the Du Bois shops of the Buffalo, Rochester & Pittsburgh, each one a real factor in increasing the efficiency of shop operation. Careful attention to details, elimination of much lost motion and the equipment of machines with time saving jigs and fixtures all help to increase shop output and reduce the unit costs of repair work.

The driving box equipment represents a good use of old tools for single purpose production. For machining crown brasses to fit driving boxes, a slotter (Fig. 1) has been equipped with the customary holding mandrel; the stroke has been lengthened to take brasses for extended main driving boxes and a simple, heavy feed suitable for brass cutting applied. Rapid finishing of the brasses is assured by these comparatively simple, inexpensive changes in the slotter.

Driving boxes are bored and hub liners faced on a boring mill (Fig. 2) which has been equipped with a piloted boring bar to provide rigidity and permit the taking of heavy cuts. Hub liners are faced by the second head, thus performing two operations at one setting of the driving box and making sure that the hub face is at right angles to the bore of the box. Driving box shoe and wedge ways are kept a standard width by electric welding steel liners along the driving box flanges. The edges of the liners where they are welded to the driving box are beveled, an operation cheaply performed by planing a number of liners at the same time. They are held at the proper angle in a planer chuck using suitable beveled blocks and feeding the tool across all the liners at once. To assist in holding the liners six holes are punched for "tack-welding." After welding, the driving boxes are planed to the standard widths between shoe and wedge faces called for by the blue prints.

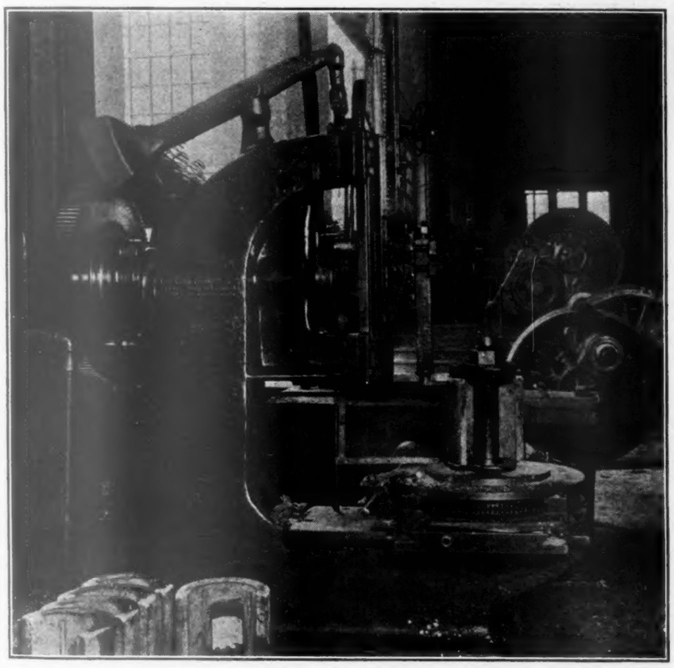


Fig. 1—Slotter Arranged for Rapid Machining of Crown Brasses

Washout plugs are quickly and accurately turned and threaded in an engine lathe (Fig. 3). Several sizes of castings are carried so as to reduce the amount of metal to be removed to an economical minimum, about ⅛ in. range being cared for by each casting. The small end of the plug is cored out to a bell shape to reduce the weight and permit quick center punching for the tail stock center.

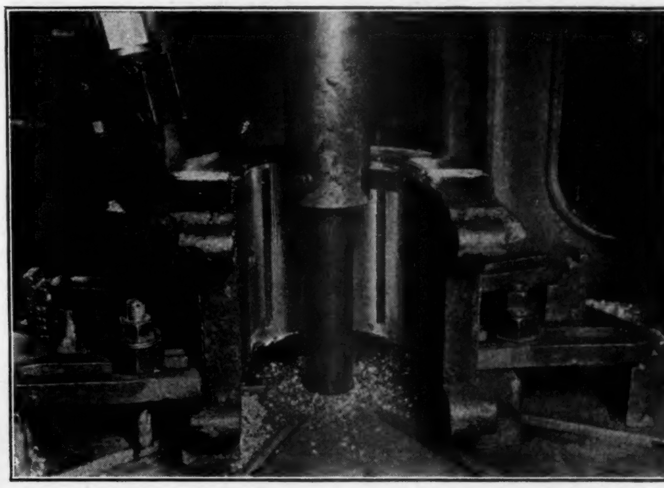


Fig. 2—Heavy Cuts Are Taken With a Piloted Boring Bar

The threading tool is a hobbed chaser (as shown on top of the tool post) held in a block fitted to take the place of the regular tool post. Grinding this tool at an angle furnishes a turning edge to precede the threading chaser. By means of an adjustable stop, the carriage travel can be regulated, permitting the taking of several cuts and yet maintaining the size where a number are made of the same size. The taper is obtained by setting over the tail stock, as this method has been found to give the best results. The strips, shown at an angle on the side of the tool block, have been provided to hold the hinged guard, protecting the workman from flying

Fig. 3—Method of Machining Washout Plugs

brass chips. The average production, working on a quantity shop order, is 100 plugs in eight hours.

An interesting method of solving a difficult shop problem

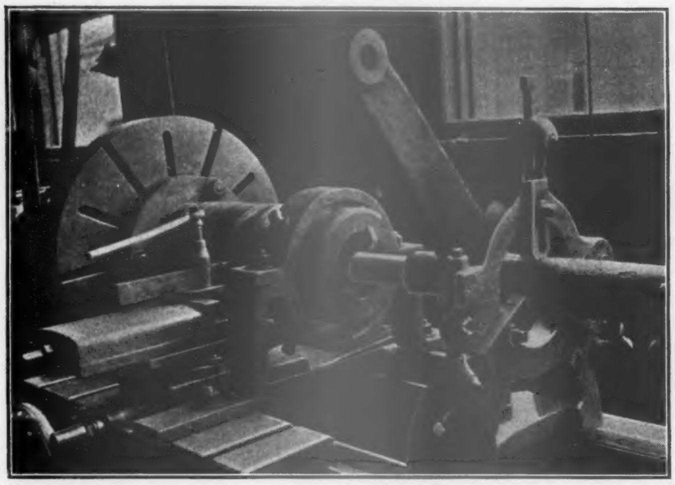


Fig. 4—Fixture for Turning Lift Shaft Bearings

is illustrated by the fixture for turning lift shaft bearings (Fig. 4). This is one of the troublesome jobs in the average shop, owing to the long arms requiring a large swing lathe

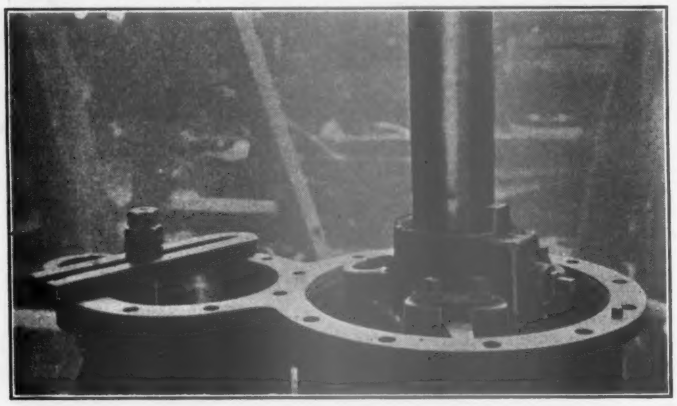


Fig. 5—Adjustable Head Used in Boring Air Compressor Cylinders

to turn them. Such a lathe in many cases is not available and as a result, the bearings are filed, a lengthy operation that does not produce accurate work. The special fixture illus-

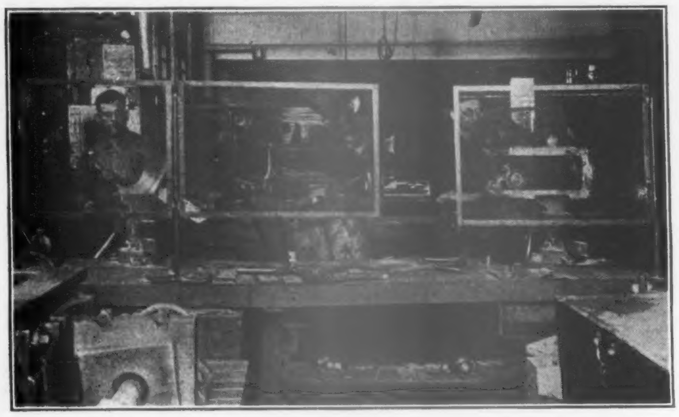


Fig. 6—Folding Screens are a Convenient and Effective Safety Device

trated has been devised and is fastened to the lathe face plate. It consists of a sleeve carrying a turning tool, capable of sliding lengthwise and keyed to a center portion, which also has a live center. The lift shaft is placed between the center in the fixture and the lathe dead center. Both the lift shaft and the outer end of the fixture are held by steady rests. Turning up to a capacity of 6 in. in diameter by 16 in. in length can be done by moving the turning sleeve with the tool bit along the shaft; such traversing motion being caused by a lathe tool engaged in a slot in the sliding sleeve.

Air compressor cylinders are accurately and quickly bored

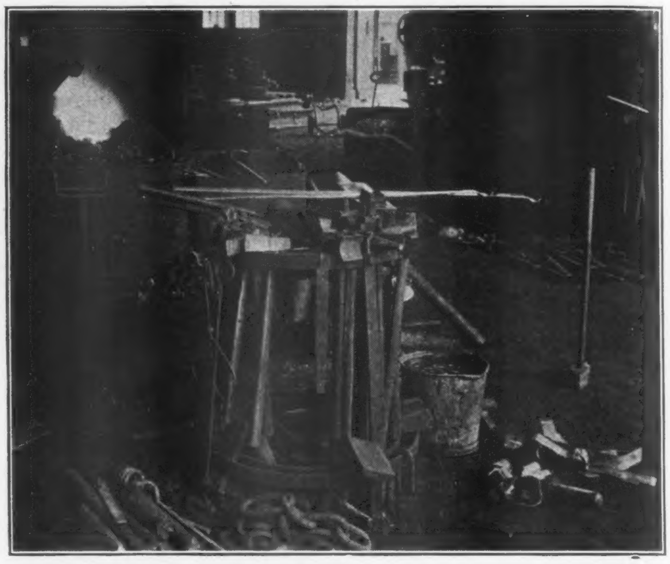


Fig. 7—Handy Tool Rack With Sheet Iron Drawer

on a radial drill press (Fig. 5), the steam cylinder of an 8½ in. cross compound compressor being shown. A regular boring tool through the bar is used for the small bore cylinders, the adjustable boring head being used for the 14½ in. cylinders. The boring bar is maintained rigid by a pilot

Fig. 8—Fixture Used in Rolling Boilers

bracket bolted to the side of the drill press table. As illustrated, a clamping bolt and cross iron through one cylinder allows the other cylinder to be swung over the side of the drill press table and the boring bar extends through the cylinder to the pilot bracket. A roughing feed of .009 in. and finishing feed of .006 in. are used.

Safeguards are everywhere in evidence in the Du Bois shops, indicative of the vigilance of the men on the safety committee, who make a general inspection of the shop every other Saturday afternoon. One very simple and valuable safety device is the screen (Fig. 6) used around vises where much chipping and filing is done, especially in the rod department. These screens when not in use can readily be folded back out of the way.

A good blacksmith shop tool rack has been devised (Fig. 7) which keeps the tools readily available and near the anvil where wanted. It consists of two concentric circles of 1½ in. by ¼ in. iron separated as shown, one pair forming the top and the other the bottom of the tool rack. A sheet iron drawer is provided in the center for keeping orders, time books, etc. It is difficult to say just how many steps and how much time are saved each day by having tools and working implements right at hand ready for use.

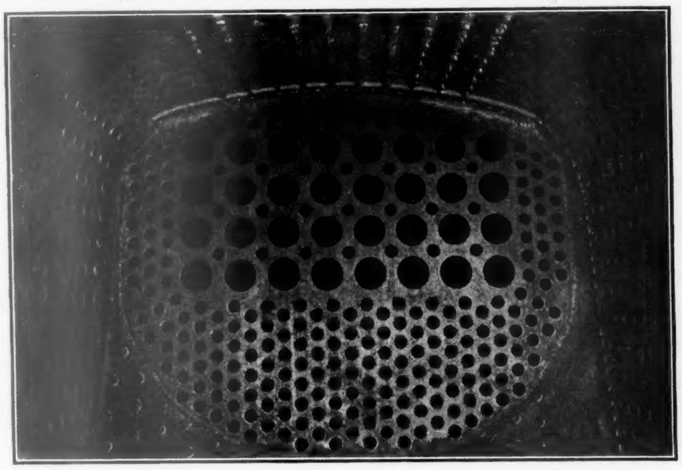


Fig. 9—Application of New Flue Hole Portion to Back Flue Sheet

Rolling boilers is quickly and easily accomplished by the fixture illustrated in Fig. 8. The boiler is slung from the main hoist hook with the steel shackle bar under the belly of the boiler. Turning to any desired position is accomplished by the cable attached to the auxiliary hoist hook.

The practice of electric welding has come into general use at Du Bois and shows excellent results, especially on boiler work. A large number of fireboxes have been applied with complete electric welded seams, except at the top of the back tube sheet, where it has been found more satisfactory to rivet to the crown sheet. Back heads are welded in completely, including the door holes. Where flue sheets require replacing solely because of cracked bridges or where a change is made from saturated to superheated steam, the flue hole portion is cut out by the torch and a new section welded in place (Fig. 9), thus requiring no renewal of staybolts or driving of mud ring rivets. Side sheets requiring renewal because of enlarged staybolt holes, or other causes except defective seams, are renewed by electrically welding a new section in place.

T. O. Edwards, auditor of the Southern Pacific, discovering that a number of employees of the road have lost Liberty Bond savings and other "nest eggs" through misrepresentation of unscrupulous promoters, has issued the following warning: "No matter how attractive the proposition may seem to be on the surface, employees, before investing their savings, should consult with some responsible banker in their community who will gladly give them frank and unbiased advice, whether they are a patron of the bank or not. There are many opportunities for sound and profitable investments at the present time, but attempts are being made every day to defraud the public and impose upon the credulous."

Chuck for Holding Hose Nuts

BY J. M. CAIRNS

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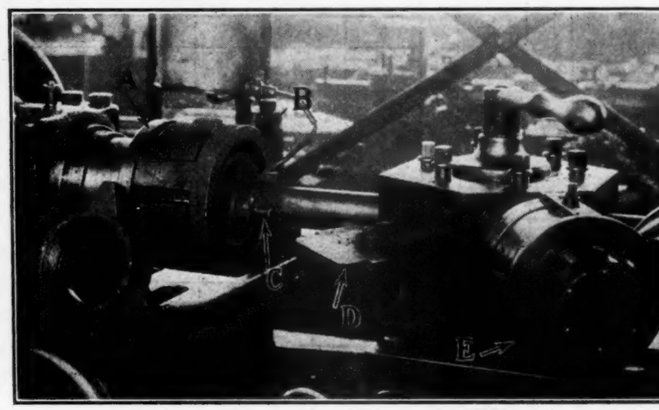
In most railroad shops a large number of hose nuts have to be machined either for local use or for other points on the system. In the quantity production of hose nuts, as all other locomotive parts, a small amount of time saved on each one means a large total saving which is well worth while. The special chuck, illustrated and described in this article, is designed to save part of the time formerly spent truing up and centering hose nuts in ordinary chucks of either the independent or universal type.

The operation of the chuck is extremely simple. As shown in the illustration, it consists of a nut holder *A* arranged to screw on the lathe spindle and slotted to receive the lugs of the nut. The ring *B* is arranged to telescope the nut holder and a partial turn engages three shoulders which prevent its slipping off again.



Special Chuck and Turret Lathe Tooling Arrangement for Machining Hose Nuts

The lathe used is a well-known type of 18 in. brass turret lathe, equipped with an internal plunger, or spindle, controlled by a lever at the head end. In operation, the hose nut is put in place with the holding ring applied and turned in the locking position. The lever is pulled back, forcing the internal plunger against the back of the nut, thus automatically locking the ring and holding the nut in a firm grip.

Hose nuts are made of malleable iron in two sizes, 3¾ in., 8 thread, and 4 in., 8 thread. They are roughed out with the boring tool *C*, the finishing size being attained by a forming drill *D*. The final operation consists of tapping out with a collapsible tap *E*, thus reducing to a minimum the total time required for setting up and machining a hose nut.

Instructions for Grinding Chilled Cast Iron Car Wheels

The following instructions and the accompanying tables, embodying the Atchison, Topeka and Santa Fe practice in grinding chilled cast iron car wheels, are abstracted from the 1920 Proceedings of the American Railroad Association, Section III—Mechanical.

The original tape size of a chilled iron wheel is shown by the number of small lugs on the back of the wheel. Wheels sent in for grinding must be taped with the standard A. T. & S. F. tape, which has special graduations for measuring worn wheels which are smaller than a Tape 1 wheel, and the original tape size must also be noted. Then, by referring to the table under the original tape size, and reading across from the actual tape size of the wheel as measured, the diameter, circumference and depth of chill can be found. If

the wheel is slid flat the flat spot must also be measured and under the column headed "Length of Flat Spot" will be found the diameter and tape to which the wheel must be ground. The depth of chill after grinding can be determined by referring to the chill corresponding to the reduced tape size.

Wheels with worn treads can be ground if the measured tape size is shown above the heavy line on the table for the original tape size of the wheel. Skidded wheels should have the greatest flat spot measured, and the wheel must then be ground the same as for a slid flat wheel as described above. In no case are slid flat wheels to be ground if the tape size and diameter necessary for grinding are under the heavy line in the table for the original size of the wheel. The flanges of wheels that have been ground must not exceed the maximum allowance of 1⅛ in. in height. If the flanges are over this limit they must be ground also.

Reference to the tables will show that $\frac{X}{1}$, $\frac{X}{2}$, $\frac{X}{3}$, etc., are markings on the standard Sante Fe tape, made for convenience in measuring worn wheels and corresponding to the definite diameters, 32⅞ in., 32 27/32 in., 32 51/64 in., 32 49/64 in., etc., respectively.

EXAMPLES

Slid Flat.—An original tape 2 wheel which measures X/3 and has a 3¼ in. flat spot must be ground to tape X/7, or 32 39/64 in. in diameter. The chill is 9/16 in., which is reduced by grinding to 31/64 in.

Tread Worn.—An original tape 3 wheel which measures X/2 on re-taping would grind to X/2 but could not be ground if the re-taped size fell below the minimum, or X/8.

GRINDING DIAMETER FOR SLID FLAT WHEELS — DIMENSIONS AT TOP OF COLUMNS INDICATE LENGTHS OF FLAT SPOTS.

Tape Size	Diameter In.	Circular	Chill In.	2" Tape	2" Dia. In.	2¼" Tape	2¼" Dia. In.	2½" Tape	2½" Dia. In.	2¾" Tape	2¾" Dia. In.	3" Tape	3" Dia. In.	3¼" Tape	3¼" Dia. In.	3½" Tape	3½" Dia. In.	3¾" Tape	3¾" Dia. In.	4" Tape	4" Dia. In.	4¼" Tape	4¼" Dia. In.	4½" Tape	4½" Dia. In.	4¾" Tape	4¾" Dia. In.	5" Tape	5" Dia. In.	5¼" Tape	5¼" Dia. In.
1	32 59/64	103.42	11/16	X/1	32 55/64	X/1	32 27/32	X/1	32 53/64	X/2	32 51/64	X/2	32 25/32	X/3	32 49/64	X/4	32 47/64	X/5	32 45/64	X/5	32 43/64	X/6	32 41/64	X/7	32 39/64	X/8	32 37/64	X/9	32 35/64	X/9	32 33/64
X	32⅞	103.29	43/64	X/2	32 13/16	X/2	32 51/64	X/3	32 25/32	X/3	32 49/64	X/3	32¾	X/4	32 23/32	X/5	32 11/16	X/6	32 21/32	X/7	32⅝	X/7	32 19/32	X/8	32 9/16	X/9	32 17/32	X/10	32½		
X/1	32 27/32	103.17	41/64	X/3	32 25/32	X/3	32 49/64	X/3	32¾	X/4	32 47/64	X/5	32 45/64	X/5	32 11/16	X/6	32 21/32	X/7	32⅝	X/7	32 19/32	X/8	32 9/16	X/9	32 17/32	X/10	32½				
X/2	32 51/64	103.05	39/64	X/4	32 47/64	X/4	32 23/32	X/5	32 45/64	X/5	32 43/64	X/6	32 21/32	X/6	32 41/64	X/7	32 39/64	X/8	32 37/64	X/9	32 35/64	X/9	32 33/64	X/10	32 31/64						
X/3	32 49/64	102.92	39/64	X/5	32 45/64	X/5	32 11/16	X/5	32 43/64	X/6	32 41/64	X/7	32⅝	X/7	32 39/64	X/8	32 37/64	X/9	32 35/64	X/9	32 33/64	X/10	32 31/64								
X/4	32 23/32	102.80	37/64	X/6	32 21/32	X/6	32 41/64	X/7	32⅝	X/7	32 19/32	X/8	32 37/64	X/8	32 9/16	X/9	32 17/32	X/10	32½												
X/5	32 11/16	102.67	37/64	X/7	32⅝	X/7	32 39/64	X/7	32 19/32	X/8	32 9/16	X/9	32 35/64	X/9	32 17/32	X/10	32½														
X/6	32 41/64	102.55	37/64	X/8	32 37/64	X/8	32 9/16	X/9	32 35/64	X/9	32 33/64	X/10	32½																		
X/7	32 39/64	102.42	9/16	X/9	32 35/64	X/9	32 17/32	X/9	32 33/64	X/10	32 31/64																				

Tape 1—Original

Tape Size	Diameter In.	Circular	Chill In.	2" Tape	2" Dia. In.	2¼" Tape	2¼" Dia. In.	2½" Tape	2½" Dia. In.	2¾" Tape	2¾" Dia. In.	3" Tape	3" Dia. In.	3¼" Tape	3¼" Dia. In.	3½" Tape	3½" Dia. In.	3¾" Tape	3¾" Dia. In.	4" Tape	4" Dia. In.	4¼" Tape	4¼" Dia. In.	4½" Tape	4½" Dia. In.	4¾" Tape	4¾" Dia. In.	5" Tape	5" Dia. In.	5¼" Tape	5¼" Dia. In.	5½" Tape	5½" Dia. In.
2	32 61/64	103.54	43/64	X	32 57/64	X	32⅞	X/1	32 55/64	X/1	32 53/64	X/2	32 13/16	X/2	32 51/64	X/3	32 49/64	X/4	32 47/64	X/5	32 45/64	X/4	32 43/64	X/6	32 41/64	X/7	32 39/64	X/8	32 37/64	X/9	32 17/32	X/10	32 31/64
1	32 59/64	103.42	41/64	X/1	32 55/64	X/1	32 27/32	X/1	32 53/64	X/2	32 51/64	X/3	32 25/32	X/3	32 49/64	X/4	32 47/64	X/5	32 45/64	X/5	32 43/64	X/6	32 41/64	X/7	32 39/64	X/8	32 37/64	X/9	32 35/64	X/9	32 33/64	X/10	32 15/32
X	32⅞	103.29	⅝	X/2	32 13/16	X/2	32 51/64	X/3	32 25/32	X/3	32 49/64	X/3	32¾	X/4	32 23/32	X/5	32 11/16	X/6	32 21/32	X/7	32⅝	X/7	32 19/32	X/8	32 9/16	X/9	32 17/32	X/10	32½				
X/1	32 27/32	103.17	39/64	X/3	32 25/32	X/3	32 49/64	X/3	32¾	X/4	32 47/64	X/5	32 45/64	X/5	32 11/16	X/6	32 21/32	X/7	32⅝	X/7	32 19/32	X/8	32 9/16	X/9	32 17/32	X/10	32½						
X/2	32 51/64	103.05	37/64	X/4	32 47/64	X/4	32 23/32	X/5	32 45/64	X/5	32 43/64	X/6	32 21/32	X/6	32 41/64	X/7	32 39/64	X/8	32 37/64	X/9	32 35/64	X/9	32 33/64	X/10	32 31/64								
X/3	32 49/64	102.92	9/16	X/5	32 45/64	X/5	32 11/16	X/5	32 43/64	X/6	32 41/64	X/7	32⅝	X/7	32 39/64	X/8	32 37/64	X/9	32 35/64	X/9	32 33/64	X/10	32 31/64										
X/4	32 23/32	102.80	35/64	X/6	32 21/32	X/6	32 41/64	X/7	32⅝	X/7	32 19/32	X/8	32 37/64	X/8	32 9/16	X/9	32 17/32	X/10	32½														
X/5	32 11/16	102.67	33/64	X/7	32⅝	X/7	32 39/64	X/7	32 19/32	X/8	32 9/16	X/9	32 35/64	X/9	32 17/32	X/10	32½																
X/6	32 41/64	102.55	½	X/8	32 37/64	X/8	32 9/16	X/9	32 35/64	X/9	32 33/64	X/10	32½																				
X/7	32 39/64	102.42	31/64	X/9	32 35/64	X/9	32 17/32	X/9	32 33/64	X/10	32 31/64																						

Tape 2—Original

Tables Used on the Atchison, Topeka & Santa Fe to Determine Whether Chilled Iron Car Wheels Can Safely Be Ground

GRINDING DIAMETER FOR SLID FLAT WHEELS — DIMENSIONS AT TOP OF COLUMNS INDICATE LENGTHS OF FLAT SPOTS.

Tape Size	Diameter In.	Circular	Chill In.	2"		2¼"		2½"		2¾"		3"		3¼"		3½"		3¾"		4"		4¼"		4½"		4¾"		5"		5¼"		5½"		5¾"	
				Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.
3	33	103.67	3/16	2	32[illegible]	1	32[illegible]	1	32[illegible]	×	32⅞	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/8	32[illegible]	×/9	32[illegible]		
2	32[illegible]	103.54	[illegible]	×	32[illegible]	×	32⅞	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]	×/9	32[illegible]				
1	32[illegible]	103.42	[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]	×/9	32[illegible]						
×	32⅞	103.29	½	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32 5/16	×/9	32½								
×/1	32[illegible]	103.17	[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32 5/16	×/9	32[illegible]										
×/2	32[illegible]	103.05	[illegible]	×/4	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]	×/9	32[illegible]														
×/3	32[illegible]	102.92	[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32[illegible]	×/9	32[illegible]																
×/4	32[illegible]	102.80	[illegible]	×/6	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32[illegible]	×/8	32 5/16	×/9	32½																		
×/5	32[illegible]	102.67	[illegible]	×/7	32⅝	×/7	32[illegible]	×/7	32[illegible]	×/8	32 5/16	×/9	32[illegible]																						
×/6	32[illegible]	102.55	[illegible]	×/8	32[illegible]	×/8	32 5/16	×/9	32[illegible]																										

Tape 3—Original

Tape Size	Diameter In.	Circular	Chill In.	2"		2¼"		2½"		2¾"		3"		3¼"		3½"		3¾"		4"		4¼"		4½"		4¾"		5"		5¼"		5½"		5¾"	
				Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.
4	33[illegible]	103.80	[illegible]	3	32[illegible]	2	32[illegible]	2	32[illegible]	1	32[illegible]	1	32[illegible]	×	32[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/7	32⅝	×/8	32[illegible]	×/9	32[illegible]
3	33	103.67	[illegible]	2	32[illegible]	1	32[illegible]	1	32[illegible]	×	32⅞	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/8	32[illegible]	×/9	32[illegible]		
2	32[illegible]	103.54	[illegible]	×	32[illegible]	×	32⅞	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]	×/9	32[illegible]				
1	32[illegible]	103.42	[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]								
×	32⅞	103.29	[illegible]	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32 5/16										
×/1	32[illegible]	103.17	[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32 5/16												
×/2	32[illegible]	103.05	[illegible]	×/4	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]																
×/3	32[illegible]	102.92	[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32[illegible]																		
×/4	32[illegible]	102.80	⅜	×/6	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32[illegible]	×/8	32 5/16																				

Tape 4—Original

Tape Size	Diameter In.	Circular	Chill In.	2"		2¼"		2½"		2¾"		3"		3¼"		3½"		3¾"		4"		4¼"		4½"		4¾"		5"		5¼"		5½"		5¾"	
				Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.	Tape	Dia. In.
5	33[illegible]	103.92	½	3	33[illegible]	3	33	3	32[illegible]	2	32[illegible]	2	32[illegible]	1	32[illegible]	×	32[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]
4	33[illegible]	103.80	[illegible]	3	32[illegible]	2	32[illegible]	2	32[illegible]	1	32[illegible]	1	32[illegible]	×	32[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/7	32⅝	×/8	32[illegible]	×/9	32[illegible]
3	33	103.67	[illegible]	2	32[illegible]	1	32[illegible]	1	32[illegible]	×	32⅞	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/8	32[illegible]	×/9	32[illegible]		
2	32[illegible]	103.54	[illegible]	×	32[illegible]	×	32⅞	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]	×/9	32[illegible]				
1	32[illegible]	103.42	[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/1	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32[illegible]	×/8	32[illegible]								
×	32⅞	103.29	[illegible]	×/2	32[illegible]	×/2	32[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32 5/16										
×/1	32[illegible]	103.17	[illegible]	×/3	32[illegible]	×/3	32[illegible]	×/3	32¾	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32 5/16												
×/2	32[illegible]	103.05	[illegible]	×/4	32[illegible]	×/4	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/6	32[illegible]	×/7	32[illegible]																		
×/3	32[illegible]	102.92	[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/5	32[illegible]	×/6	32[illegible]	×/7	32⅝	×/7	32[illegible]	×/8	32[illegible]																		

Tape 5—Original

Tables Used on the Atchison, Topeka & Sante Fe to Determine Whether Chilled Cast Iron Car Wheels Can Safely Be Ground

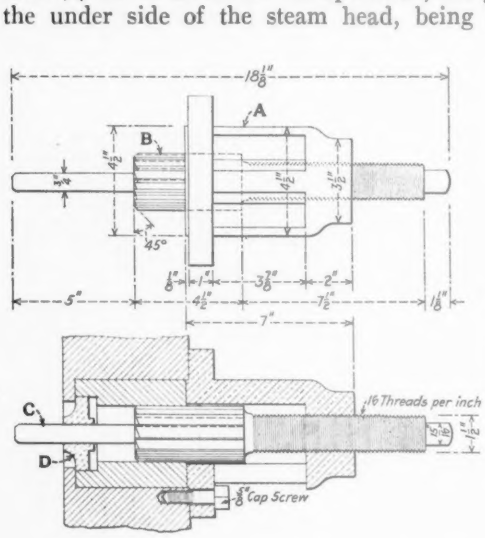
Reaming Reversing Valve Bushings

BY CHARLES W. SCHANE

Apprentice Instructor, Erie Repair Shops, Huntington, Ind.

The jig illustrated herewith has proved an effective device for reaming worn reversing valve bushings in the steam heads of New York air compressors. The bushings can be reamed without removing the compressor from the engine or taking off the steam head and on account of this feature, the device has proved of great value in saving time at roundhouses and reducing the number of air compressor failures. A pair of reversing valve bushings can be reamed and new packing rings fitted and applied in an hour's time by one machinist.

As shown in the illustration, the jig consists of a body *A* arranged to be fastened to the under side of the steam head in place of the reversing valve cap by means of five $\frac{5}{8}$ in. cap screws. The reamer *B* is made in one solid piece with one end threaded to advance the reamer, the extreme end being squared for a wrench. The other end consists of a piloting stem $\frac{3}{4}$ in. in diameter. In operation, the jig is attached to the under side of the steam head, being held securely in



Device for Reaming Reversing Valve Bushings

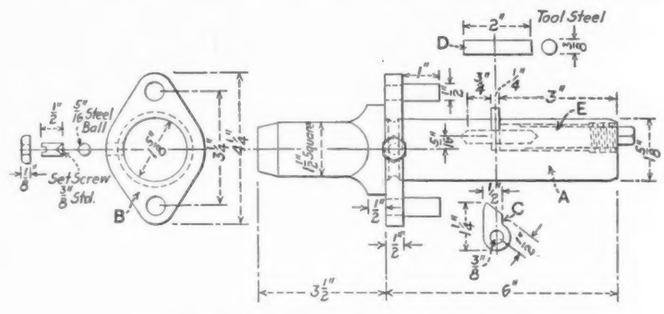
place by the cap screws. The reamer is guided by the piloting stem *C* which is a running fit in bushing *D*. As the reamer is turned, it advances into the bushing and when fed in the full distance, leaves a smooth, true hole to which the reversing valve packing rings may be fitted.

On account of the reaming action being upward, the chips fall out of the valve chamber into the body of the jig and may be brushed away through the apertures shown. This prevents any possibility of chips getting into the valves of cylinders of the air compressor.

Liberty Flue Cutter

A device known as the Liberty flue cutter has given exceptionally satisfactory service in the Horton shops of the Chicago, Rock Island & Pacific for cutting out flues in front ends. Referring to the illustration, mandrel *A* is made of tool steel, slightly less than $1\frac{5}{8}$ in. in diameter and provided with a $1\frac{1}{2}$ in. square end for driving. Plate *B*, made of $\frac{1}{2}$ in. stock, is arranged to turn freely on the mandrel and form a positive stop when the mandrel is inserted in the boiler flue. Plate *B* is held against the shoulder on the mandrel and allowed to turn freely by means of the steel ball, $\frac{3}{8}$ in. set screw, and lock nut as shown, the steel ball rolling in a groove in the mandrel *A*.

The cutting knife *C* is made of carbon steel shaped as indicated with a shoulder to take the direct thrust and arranged to be held in the mandrel *A* by means of the steel pin *D*. The slight radius at the point of the knife *C* makes possible a shearing action which shears the thickness of the flue and width of the knife in one revolution from the time the knife begins to cut. Very little power is required for this



An Effective, Easily Made Flue Cutter

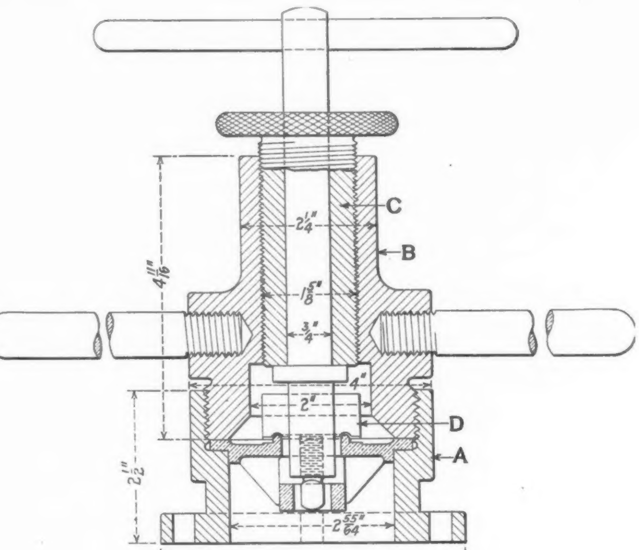
operation. The steel pin *D* is held in place by means of pin holder *E* which is also made of tool steel. All wearing parts of the Liberty flue cutter are case hardened to increase their resistance to wear.

Emergency Seat Refacing Tool

BY JOHN FLINNER

Air Brake Inspector, Pittsburgh & Lake Erie, McKeesport, Pa.

A special tool designed to reface the brass seats of emergency valves applied to Westinghouse triple valves of either the passenger or freight type is shown in the illustration. The emergency valve seat is placed in the base *A* of the fixture as shown. Part *B*, provided with two handles, is arranged to turn into the base *A*, holding the brass emergency



Tool for Refacing Emergency Valve Seats

valve seat firmly in place. An adjusting screw *C* may be turned down by hand against a shoulder on the valve stem carrying the cutting tool *D*. This cutting tool is double acting, so ground as to give the required shape to the valve seat. It is held in place by means of a square-headed set screw as shown.

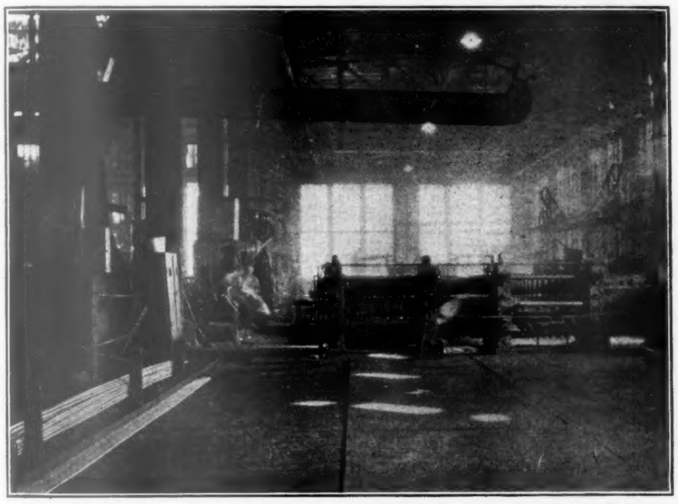
This emergency valve seat refacing tool has been used with good results as it makes possible the refacing of valve seats that become worn or cut in service. In addition, old style valve seats may be refaced, giving them the improved semi-circular section shown, which has been found to give better service.

A Profitable Railroad Reclamation Project

170 Tons of Bar Iron a Month Rolled From Bundled Scrap at Beech Grove Shops of the "Big Four"

ESTABLISHED early in 1918 for the purpose of re-rolling bar scrap, the rolling mill at the Beech Grove (Indianapolis, Ind.) shops of the Cleveland, Cincinnati, Chicago & St. Louis has since been adapted to the reclamation of miscellaneous wrought iron scrap at a materially greater profit than was realized under the original re-rolling practice.

The rolling mill was placed in operation in April, 1918, at a time when materials of all kinds were exceedingly difficult to secure. The railroad had on hand a large accumulation of scrap, including considerable quantities of old truss rods, arch bars and other miscellaneous material of rectangular cross section, suitable for re-rolling into useful bar stock.



Rear View of the Mill Showing the Cooling Bed and the Jib Crane for Handling the Finished Bars

At the outset the mill was operated along conventional lines of re-rolling practice. Both the roughing and finishing rolls were fitted with the usual alternate oval and circular passes. Heating and re-rolling were the only operations performed on round iron, while flat sections were split before being rolled.

Several stages of development were passed through before the present practice was established. One of these was the use of splitting rolls on the roughing side of the mill, so that flat sections might be split hot and re-rolled at the same time. This practice, however, did not always eliminate the necessity of reheating half of the split material before it could be rolled and saved only the shearing operation. During the early history of the plant some attention was given to the production of rectangular sections in the rolls but considerably greater difficulties are encountered in the operation of the mill on rectangular work than in the production of circular sections. As the demand for round bar stock is great enough to keep the mill busy, its operation is now confined exclusively to the production of that class of material.

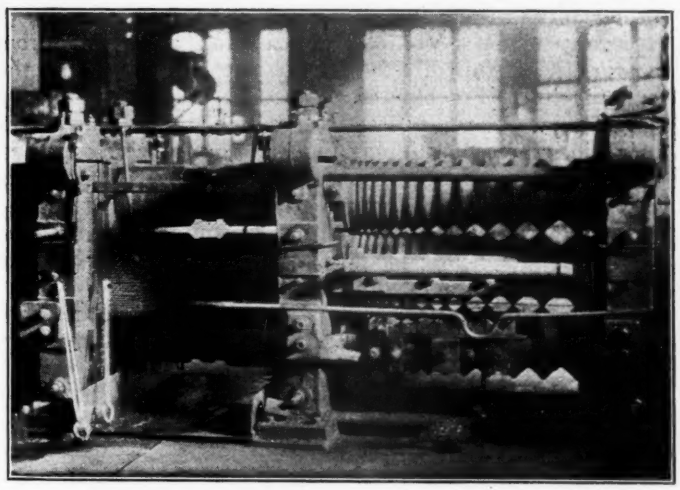
A careful study of the operation of the mill developed the fact that, under the local conditions, the profit was not large from strictly re-rolling operations. Under the present method of operation the rolling mill serves as a means of reclaiming practically all of the miscellaneous wrought iron scrap accumulating on the road. Scrap iron bars and trimmings of all sizes are sheared and bundled and then rolled into round bar stock ranging from ⅝ in. to 1½ in. in diameter, practically supplying the needs of the railroad for this class of material, at an average monthly net profit of over $3,500.

The Rolling Mill Equipment

The rolling mill is located in the blacksmith shop and occupies a total floor space of approximately 45 ft. by 120 ft. The equipment consists of an Ajax B, 14-in. mill driven by a 100-hp. motor, a shop built furnace with double heating chambers each measuring 7 ft. by 5 ft. 6 in. inside, hot tables for the roughing and finishing rolls on the furnace side of the mill, a metal floor and a straightening bed of old rails at the back side of the mill.

The furnace is 18 ft. in length and the two heating chambers are separated by a partition wall. Each chamber is heated by two oil burners, the two sets of burners being located at opposite ends of the structure. The four burners consume about 48 gal. of oil an hour. Each heating chamber is provided with two door openings and normally its charge consists of 12 bundles of scrap. Both ends of the furnace are used continuously; a fresh charge is heating in one end while that in the other is being rolled.

The present operation of the mill on bundled scrap was made possible by the adoption of the so-called Gothic roughing rolls. The characteristic form of the passes in these rolls is shown in one of the illustrations. The rolls were



The Roughing Rolls, Showing the Form of the Gothic Passes

cast in a local steel foundry, of electric steel poured around cores of steel rails, and were machined in the railroad shops.

Operating Practice

For some time the rolling mill has normally been in operation 16 hours daily and a total complement of 19 men is required for the two shifts. Each shift is made up as follows:

One head roller (day shift only)
One roller (night shift only)
One heater
One heater helper
One rougher } (on the furnace side of the mill)
One finisher }
One catcher } (on the turning floor side)
Two helpers }
Three laborers piling scrap (day shift only)

The roller, heater, rougher finisher and catcher are rated as blacksmiths while the head roller receives a differential. The others receive the regular rates for helpers and laborers.

It is worthy of note that the head roller, in direct charge of the operation of the mill, is an experienced rolling mill operator, and to this fact may be attributed, in no small measure, the successful development of the present practice.

The scrap material comes to the rolling mill from two sources. The greater part of the round stock comes from the scrap yard, where radial stays, staybolts and other rod and bolt scrap accumulates from all points on the system. The long pieces, such as radial stays, tie rods, etc., are sheared to 24-in., 30-in., and 36-in. lengths so that they may be used as foundations for the piles. The greater part of the flat and square bar scrap is made up of trimmings which accumulate in the blacksmith shop itself. This material is collected from various locations in the shop and the accumulation moved by crane to a point adjoining the rolling mill. Here the pieces are trimmed to conform to the lateral dimensions of the bundles and the bundles assembled.

The bundles are made in lengths of 24 in., 30 in., and 36 in., depending on the size of the stock to be rolled. All are 4½ in. square and each bundle is bound by two No. 8 iron wires. The composition of the bundles is clearly shown in one of the illustrations. The foundation is a layer of round material, sheared to length and laid on the two binding wires, which are bent to shape. The pile is then built up of miscellaneous flat and short round pieces and finished at the top with another layer of round material laid longitudinally. The piles average in weight about 94 to 100 lb. for the 24-in., 115 lb. for the 30-in., and 140 lb. for the 36-in. length. The 24-in. piles are used for rolling ⅝-in., ¾-in., and ⅞-in. stock and the 30-in. pile is used for 1-in. to 1½-in. stock. These two sizes take care of by far the greater part of the output, although the 14-in. rolling mill is capable of handling up to 2-in. finished stock. For bars over 1½ in. in diameter the 36-in. piles are used.

The mill is operating with an average furnace loss not exceeding eight per cent. The piled scrap, as it comes from the furnace, is run directly through the largest pass on the roughing rolls. For bundles of the size used extensive ragging is unnecessary; a few small radial grooves chipped in their sides prevent slipping in the first roughing passes. The material is worked down through the roughing passes until only a few passes through the finishing rolls are necessary. On the 1-in. material the bars go through nine roughing and four finishing passes. The welding up of the piles is completed in the first three or four passes.

The straightening bed adjoins the center bay of the shop, which is served by a traveling crane. As the finished bars cool they are piled just back of the straightening bed as shown in one of the illustrations. When a pile, such as that shown, accumulates, one end is lifted and swung under the traveling crane by the post gib crane shown in the upper foreground of the photograph. The pile is then moved to the shears, located just across the shop, where the bars are cut up into bolt lengths for the forging machine furnaces.

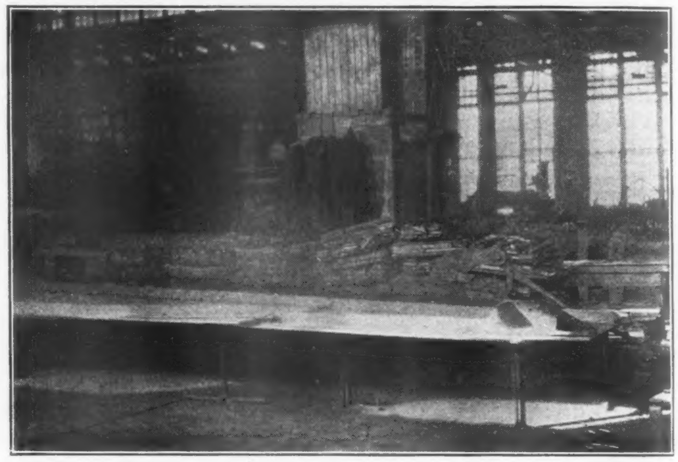
In the usual re-rolling mill practice, alternate oval and circular passes are used throughout the process. The passes on the Gothic roughing rolls, however, are all of similar form, with the longitudinal diagonal longer than the vertical and the bar as it comes from each pass is given a quarter turn about its axis before entering the next smaller pass in the rolls.

The rolling mill itself is in actual operation about one-half of the time. The remainder is taken up in recharging the heating chambers following each run of twelve bars. Under normal operating conditions each eight-hour shift produces from five to eight tons of finished bar stock, depending on the length of the bundles and the diameter of the finished bars.

The original finishing rolls are still in operation and there has never been a failure of any part of the mill. The only repair which so far has been required was the renewal of one bearing.

In addition to the average furnace loss of eight per cent, an additional two per cent is lost in defective bars and waste in cutting up to bolt lengths. This loss, however, has been found to be less than the normal cropage encountered in cutting up merchant bars because of the more economical use that can be made of bars running from 40 to 60 ft. in length than is possible with the merchant bar lengths.

The quality of the material is excellent. Assuming that proper care is exercised in heating, the working over of the bundled scrap adds to the refinement of the iron and the comparatively loose structure of the bundles causes a more complete working of the material in the center than would take place in solid billets of the same size. The finished



Bundled Iron Scrap Ready for the Furnace

bars are homogeneous in structure and show good fractures. Tensile tests indicate that the material averages the following physical properties:

Tensile strength, lb. per sq. in.	50,152
Yield point, lb. per sq. in.	33,539
Elongation, per cent in 2 in.	27
Reduction of area, per cent	43

Average of 25 tests. Slight admixture of steel obtained from common iron reclaimed.

A comparatively small proportion of reworked material enters into the scrap, most of which consists of flat sections with an appreciable percentage of staybolts. An inspection of the make-up of the piled scrap as shown in one of the illustrations, remembering that the mill rolls only bolt stock, shows that there is no danger of a deterioration in the quality of the rolling mill output due to repeated reworking of the same material.

Re-Rolling Steel Scrap

Although probably 90 to 95 per cent of the output of the rolling mill is wrought iron stock, an occasional accumulation of material such as steel arch bars and coupler yokes is run through the mill. Only re-rolling operations are employed on steel, but here also the Gothic roughing rolls have demonstrated their value.

Instead of splitting rectangular sections, such as arch bars, it is possible to rough down the full size sections through the Gothic rolls, thus eliminating the shearing operations and half of the rolling operations.

Accounting

In arriving at the cost of operation of the mill, it bears a portion of all fixed charges against the department of which the rolling mill forms a part. The mill occupies approximately 5,000 sq. ft. of floor space and employs 19 men. Interest at 6 per cent is charged against the mill operation on a portion of the cost of the building, bearing the same

ratio to the total as the ratio of the floor space occupied by the rolling mill to the total floor space in the blacksmith shop building.

REPORT OF BEECH GROVE ROLLING MILL OPERATION FOR THE MONTH OF OCTOBER, 1920

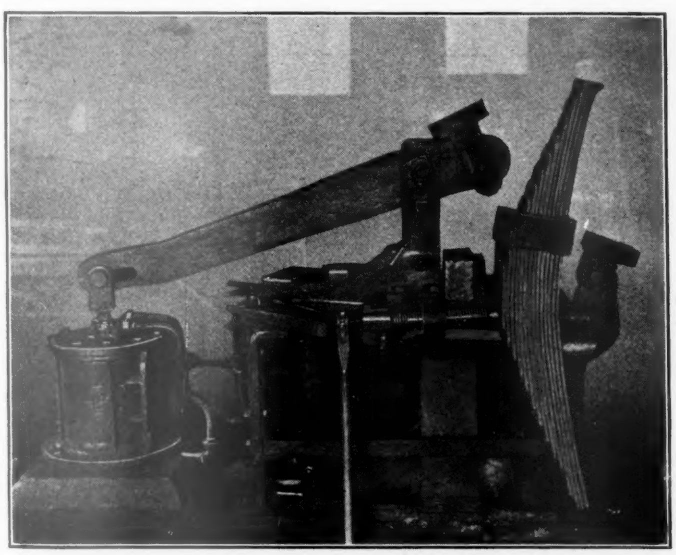
Scrap to furnace—		
370,720 lb. at $21.10 G. T.		$3,492.05
Fixed charges on mill and building for housing—		
Interest at 6 per cent rate per year	$168.71	
Depreciation	207.54	
Taxes at 1.8 per cent	47.45	
Insurance at .2 per cent	5.27	
Repairs at 3 per cent	83.33	
		512.30
Labor direct charge		2,655.66
398½ fuel hours at $1.86 per hour		741.21
398½ power hours at .30 per hour		209.55
26 days' supervision at $5 per day		130.00
		$7,740.77
Finished product—		
175,900 lb. ¾-in. rod iron at $3.35 cwt	$5,892.65	
118,940 lb. ⅞-in. rod iron at $3.35 cwt	3,984.49	
50.300 lb. ⅝-in. rod iron at $3.40 cwt	1,710.20	
		11,587.34
Net profit for the month		$3,846.57
Net profit since April 11, 1918		36,225.87

In the same way a portion of the cost of the department's supervision is charged against the rolling mill operation bearing the same ratio to the total cost of supervision as the number of men employed in the rolling mill bears to the total number of men employed in the department. Interest at 6 per cent is also charged on the cost of the equipment and its installation and depreciation is charged at the rate of 5 per cent on the mill, 50 per cent on the furnace and 2 per cent on the floor space.

A statement showing the results of the operation of the mill for the month of October, 1920, is presented in the table.

Easily Made Spring Bander

For railway blacksmith shops handling a large amount of spring repair work, there is no question about the need for a modern, powerful spring banding machine. With sufficient springs to keep such a machine busy practically eight hours a day, enough time and money will be saved to pay a good return on the capital invested. For outlying points,



Spring Banding Machine Suitable for Small Shops

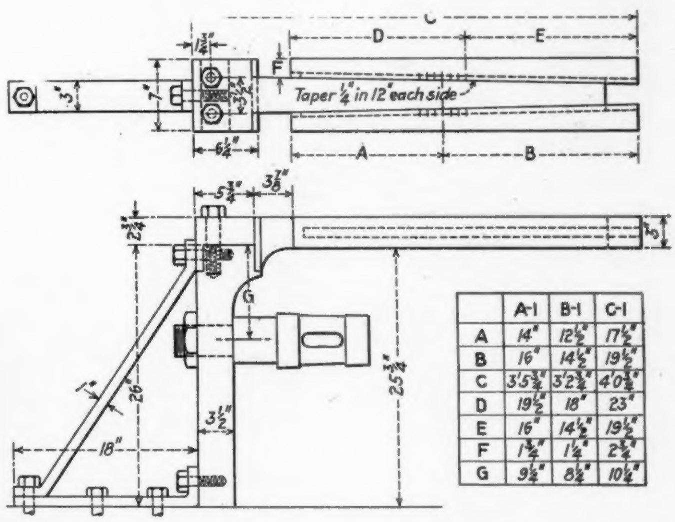
however, where it is necessary to reband a spring occasionally for emergency work, some sort of inexpensive machine must be provided to perform the operation. The machine illustrated was designed for this purpose, using scrap air cylinders and reclaimed materials throughout, at a cost probably not exceeding $250.

As shown in the illustration, the device consists of a substantial base plate mounted upon an iron frame work with the two operating levers moved by means of air cylinders. The ratio of the arms is such that with 80 lb. air pressure in the cylinders, ample power is provided to compress the spring band. While the strokes are not adjustable, it is possible by means of blocks of different thicknesses to accommodate a spring of any standard size.

In operation, the spring leaves are assembled in the correct order in a horizontal position on the table of the machine. The jack screw, illustrated, is used to press the leaves firmly together; then the spring is swiveled to a vertical position and the heated band slipped in place. After this operation the spring is swiveled back to the horizontal position, the movable jaws swung into place, and suitable blocks applied depending upon the spring size. Pressure is applied to the air cylinders and the heated band firmly pressed around the spring leaves in the usual manner.

Crosshead Babbitting Devices Eliminate Machining

It is a general practice to take up wear and maintain crosshead gibs to standard dimensions by babbitting. In most cases a mandrel of some nature is used and sufficient babbitt is poured into the gib to permit of machining it to the proper width and thickness. This involves two distinct operations and requires considerably more time than would be needed if just the right amount of babbitt could be put on in the first place and no machining was necessary. In order to



	A-1	B-1	C-1
A	14"	12½"	17½"
B	16"	14½"	19½"
C	3'5¾"	3'2¾"	4'0¾"
D	19½"	18"	23"
E	16"	14½"	19½"
F	1¾"	1¼"	2¾"
G	9¼"	8¼"	10¼"

Fig. 1—Details of Fixture Used in Babbitting Alligator Crosshead Gibs

save the time ordinarily required for machining, a large railroad system has developed the series of interesting and ingenious jigs and mandrels described in this article.

Alligator Type Crosshead

Details of the fixture used for babbitting alligator crosshead gibs are shown in Fig. 1 and the actual operation of pouring in Fig. 2. Referring to Fig. 1, the operation of the device will be practically self-evident. Three fixtures are provided for three types of alligator crossheads of various widths of guides and distances between guides. The three classes have been designated A-1, B-1 and C-1 for purposes of identification.

The crossheads are preheated by lowering them into the molten babbitt. On removal from the babbitt, they are cleaned of all surplus babbitt and dirt, being placed on the mandrel ready to pour one gib. The crosshead is not keyed on the mandrel, but is driven firmly in place. The guide

width is cared for by setting the taper gibs of the jig, these gibs also having been preheated at the same time as the crosshead. Side play is equalized by using small wedges between the crosshead gib and guide mandrel, as shown near the ladle in Fig. 2.

That the finished wearing surface will be parallel with the guide is assured by measuring with a gage, hooking under the bottom crosshead gib and measuring to the under side of the jig. A special clamp with a hand screw is used for bringing the crosshead and jig into alinement, if necessary. A common C-clamp is used to hold the taper gib in place after adjustment. Graduations shown on the taper gibs are so spaced that movement of the gibs the distance represented by one graduation will vary the total width 1/32 in. It is thus an easy matter to adjust for any width of guide.

Repeated tests have demonstrated that accurate babbitting of alligator crosshead gibs is possible with these jigs. Crossheads have been checked by laying two straight edges along the two wearing surfaces and measuring in front of the crossheads at a distance equal to the stroke. The straight edges were found to be parallel to within 1/64 in. or less.

Box Guide Suspended Type Crosshead

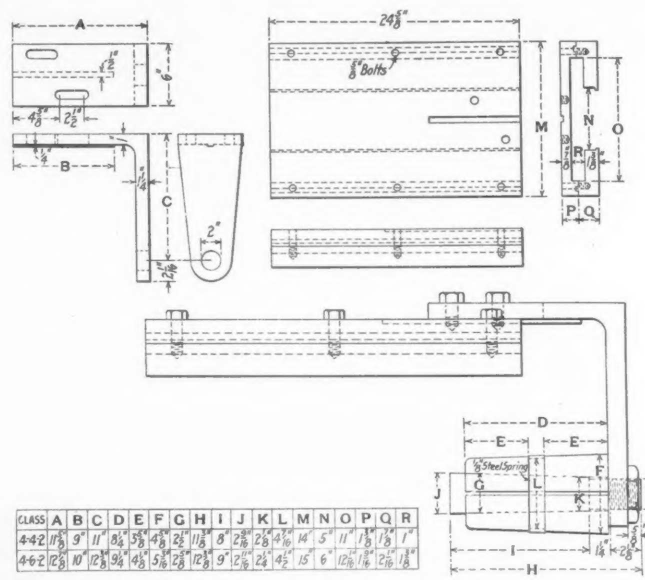
Arrangements for babbitting the four-guide, or box-guide, suspended type crosshead are made by means of the special

Fig. 2—Pouring Babbitt in Alligator Crosshead Gib

jig illustrated in Fig. 3. In this case a somewhat more complicated problem is encountered since the crosshead must be removed in such a way as not to damage the babbitt. Consequently, the jig is made collapsible, and after the babbitt has been poured it is possible to remove the two lower plates illustrated and release the crosshead from the mandrel. The jig shown in Fig. 3 is adjustable and will accommodate two classes of crossheads as shown in the table. Longitudinal adjustment of the box can be made by loosening up two bolts, as shown, correct alinement being maintained by means of the tongue and groove arrangement indicated. Particular attention is called to the construction of the mandrel for holding the crosshead. It is made in three sections, being held on the taper pin by means of a 1 in. steel spring. The taper pin has one threaded end extending through the back plate and held by means of a 2 in. nut. Tightening this nut will, of course, expand the mandrel sections until they fit accurately and tightly the taper hole in the crosshead. It is possible by means of this jig to accurately aline a box guide suspended type crosshead and babbitt it so that no further machining is necessary.

Valve Stem Crosshead

To take up wear, valve stem crossheads also require babbitting and in most cases machining. A fixture designed to eliminate the necessity for this machining is illustrated in



CLASS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
4-4-2	11 5/8"	9"	11"	8 1/4"	3 5/8"	4 5/8"	2 1/2"	11 3/8"	8"	2 9/16"	2 1/8"	4 7/16"	14"	5"	11"	1 3/8"	1 7/8"	1"
4-6-2	12 7/8"	10"	12 3/8"	9 1/4"	4 1/8"	5 3/16"	2 5/8"	12 3/8"	9"	2 11/16"	2 1/4"	4 1/2"	15"	6"	12 1/16"	1 9/16"	2 1/16"	1 3/8"

Fig. 3—Fixture for Babbitting Suspended Type Crossheads

Fig. 4. As shown, the crosshead is supported on a mandrel, corresponding to the valve stem, securely bolted to the base plate. The sides of the base plate extend about half way up the sides of the crosshead, the other half being covered by means of the cover plate shown. The cover plate is held in accurate alinement by two 60 deg. shoulders as shown in

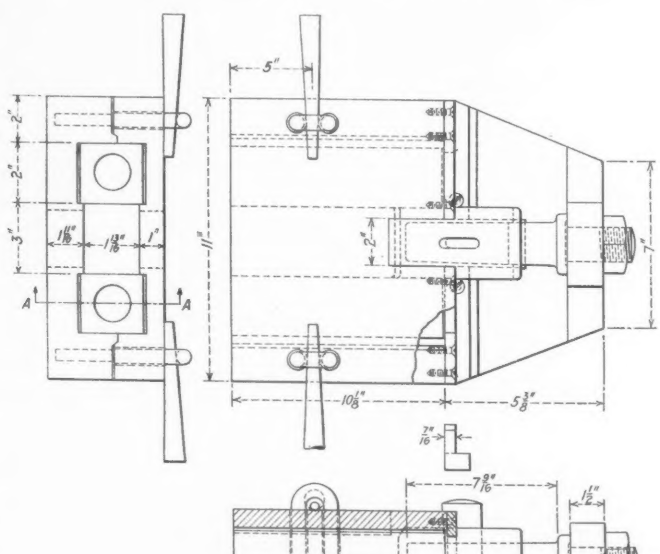


Fig. 4—Fixture for Babbitting Valve Stem Crossheads

the end view, Fig. 4. Two U-bolts, riveted in the base plate, extend through the cover plate and, in conjunction with two taper pins, provide for holding the cover plate firmly in place.

In operation, the fixture is up-ended with the crosshead in place and all small openings at the bottom are filled with clay. The babbitt is then poured. After cooling the cover plate is removed when the crosshead can be forced off by a taper key in the horizontal keyway shown.

Method for Squaring Walschaert Valve Gear

Changes Required in Various Parts May Be Determined by This Method with a Minimum of Time and Effort

BY W. J. DIXON

Assistant Master Mechanic, Baltimore & Ohio, Holloway, Ohio

BEFORE attempting to set the valves on a locomotive equipped with the Walschaert gear, a careful check should be made to determine whether such parts as the reach rod, tumbling shaft arms, radius rod hangers, union links, etc., are of the correct dimensions. After the above mentioned parts have been proved and the port openings correctly scribed on the valve stem, the engine should be run over, catching the dead centers in the usual way.

To determine the changes to make in the gear as based on the tram marks on the valve stem, an easy way is to proceed

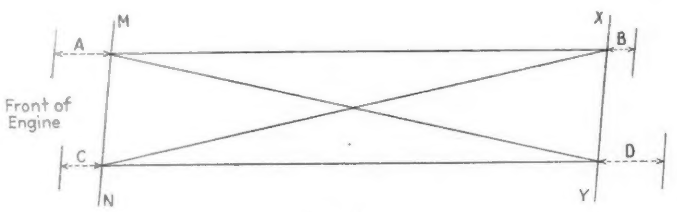


Fig. 1

according to the following method:

Assume that lines MN and XY, in Fig. 1, represent the two port marks on the valve stem, and A, B, C, D are the tram measurements from the port marks:

Rule I:

$(A + C) - (B + D)$ divided by 4 = valve rod change.

Rule II:

$(A + D) - (B + C)$ divided by 4 = eccentric rod change, *at valve stem.*

Rule III:

$(A + B) - (C + D)$ divided by 4 = crank arm change, *at valve stem.*

In making the above computations it is understood the lesser is subtracted from the greater which might reverse the

Fig. 2

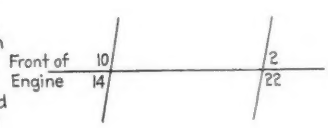


Fig. 3

above combination. For example, to compute the valve rod change we might have $(B + D) - (A + C)$, etc.

Example 1

Taking a practical example, assume the diagram shown in Fig. 2 represents the valve stem reading. The numbers indicate the measurements from port marks in thirty-seconds of an inch. The forward motion is shown below, while the back motion appears above the center line, the front of the engine being at the left.

To obtain the valve rod changes using Rule I:

$$(4 + 24) - (8 + 12) = 8$$
$$8 \text{ divided by } 4 = 2, \text{ or } 1/16 \text{ in.}$$

Therefore, the valve rod should be shortened 2/32 or 1/16 in., as there is a direct motion on this part. Making this change gives the valve stem reading as shown in Fig. 3.

Proving the above operations gives the following results:

$$(10 + 14) - (2 + 22) = 0$$

The next step is to determine the required change in the eccentric rod. Taking conditions after the valve rod alterations have been made as indicated in Fig. 3. and using Rule II:

$$(10 + 22) - (2 + 14) = 16$$
$$16 \text{ divided by } 4 = 4, \text{ or } 1/8 \text{ in.}$$

From Fig. 3 it can be seen that the valve should move back 4/32 in. Referring to Fig. 1, this change would take 4/32 from A and D and at the same time add four each to C and B. This would produce readings on the valve stem as shown in Fig. 4. To prove the correctness of the operations we have:

$$(6 + 18) - (6 + 18) = 0$$

This shows that no further change is necessary for a balance of figures either for valve rod or eccentric rod. However, the change shown above is a result obtained at the valve stem. To bring about the change, it is necessary to make a greater alteration in the eccentric rod. This is determined by multiplying the valve stem change by a factor determined by dividing the travel of the valve in full gear into the throw of the eccentric arm. For example, if the travel of the valve is 6 in. and the throw of the eccentric arm is 18 in., 18

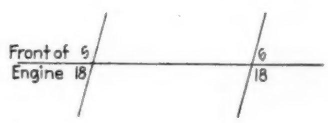


Fig. 4

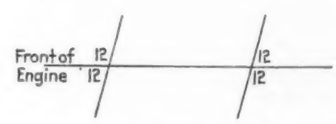


Fig. 5

divided by 6 = 3. Referring to the 4/32 in. used in Fig. 4, 4 multiplied by 3 = 12, or 3/8 in., the amount which the eccentric rod should be shortened to obtain the results shown in Fig. 4. In determining whether to lengthen or shorten the eccentric rod it should be borne in mind that when the link block is located at the bottom of the link, a direct motion exists from the eccentric crank arm pin to the valve itself. Therefore, lengthening the eccentric rod adds to D and A (Fig. 1), while B and C are diminished an equal amount. Shortening the rod has an opposite effect throughout.

Referring to Fig. 4, it will be noted that having made alterations to the valve and eccentric rods, the valve is square in both forward and back motions, but has more lead in the forward motion. To correct this proceed as follows, applying Rule III:

$$(18 + 18) - (6 + 6) = 24$$
$$24 \text{ divided by } 4 = 6$$

A 3/16-in. change in lead is needed at the valve stem. This would require a crank arm change on the main pin sufficient to give 3/16 in. more lead in the back motion. In doing this, 3/16 in. lead would automatically be taken from the forward motion, producing the results shown in Fig. 5.

Example II

Should the tram marks on the valve stem measure up as shown in Fig. 6, it is necessary to proceed as follows, using

Rule I to obtain the valve rod change:

$$(8 + 16) - (24 - 4) = (8 + 16 + 4) - 24 = 4$$
$$4 \text{ divided by } 4 = 1$$

Therefore the valve rod should be lengthened 1/32 in.

This alteration gives the diagram shown in Fig. 7. It should be borne in mind that when a tram mark on the valve stem shows blind, the measurement is negative and should be so considered when computing the change.

The eccentric rod change to correct Fig. 7 is made by applying Rule II as follows:

$$(7 + 25) - (15 - 3) = (7 + 25 + 3) - 15 = 20$$
$$20 \text{ divided by } 4 = 5, \text{ or } 5/32 \text{ in.}$$

The eccentric rod should therefore be shortened to produce 5/32 in. change on the valve stem. Making this change gives results as shown in Fig. 8.

To find the necessary change in the lead and the movement

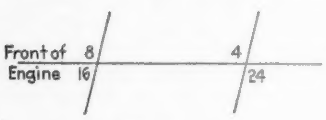


Fig. 6

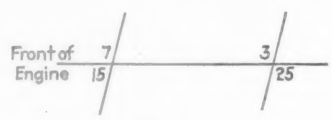


Fig. 7

of the crank arm position correcting Fig. 8, Rule III is applied as follows:

$$(20 + 20) - (2 + 2) = 36$$
$$36 \text{ divided by } 4 = 9, \text{ or } 9/32 \text{ in.}$$

The crank arm should be moved back on the main pin to produce the above change of 9/32 in. on the valve stem. Making this change produces results as shown in Fig. 9.

Referring to Figs. 5 and 9, it is seen that the valve has been squared with equal distributions in forward and back motions. By the above outlined method, it is possible to prove each operation so that the mechanic may always be sure that he is making correct changes. The three changes

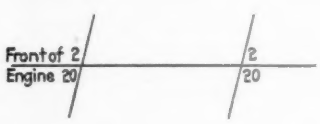


Fig. 8

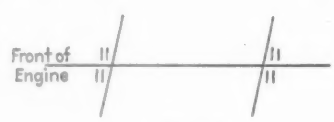


Fig. 9

may be made in any order: for instance, the eccentric or crank arm alterations may be given consideration first if desired.

In closing it may be well to call attention again to the first paragraph of this article. In order to obtain satisfactory results, the parts mentioned must be to all practical purposes perfect. Otherwise it might be possible to obtain correct readings on each valve stem separately and yet not have square valves on the locomotive.

The method of squaring valves explained above is also applicable to the Baker valve gear. It should be borne in mind that the factor used to determine the eccentric rod change always is a constant of four regardless of the valve travel and throw of the eccentric arm.

A LARGE PLANT installed an electrical thermometer system to detect any increase in temperature in its coal pile, the pyrometer being in the engineer's office. Machinery further says:

"A temperature of 250 deg. F. was considered the safe internal temperature. Portable receptacles for thermo-couples were constructed of one-inch wrought iron pipe, welded to a point at the end entering the coal pile, and the exposed end was fitted with a self-closing cap. The switches in the engineer's office were numbered and lettered to correspond with these receptacles. The engineer was thus enabled to observe the temperature readings of the coal at the different points, and to detect dangerous increases of temperature."

The Effect of Relative Humidity on Leather Belting*

BY F. W. ROYS,
Worcester Polytechnic Institute

Any one who has ever had anything to do with leather belting knows that an ordinary oak tanned leather belt, not waterproofed or weather proofed, changes its characteristics considerably with the weather conditions, and it was because no information was available regarding these effects that experiments were undertaken, the conclusions from which are quoted.

All of the experiments were made on a single specimen of

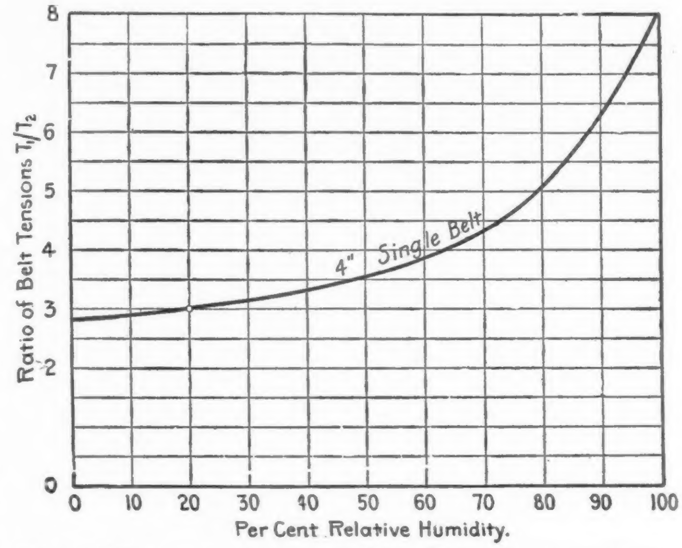


Fig. 1—Effect of Increasing Humidity; Horse Power Constant

belting, and it will not be contended that the results are applicable, directly, to any other belt. However, it is assumed that if consistent results have been obtained for this particular sample, other belts of the same sort of material will

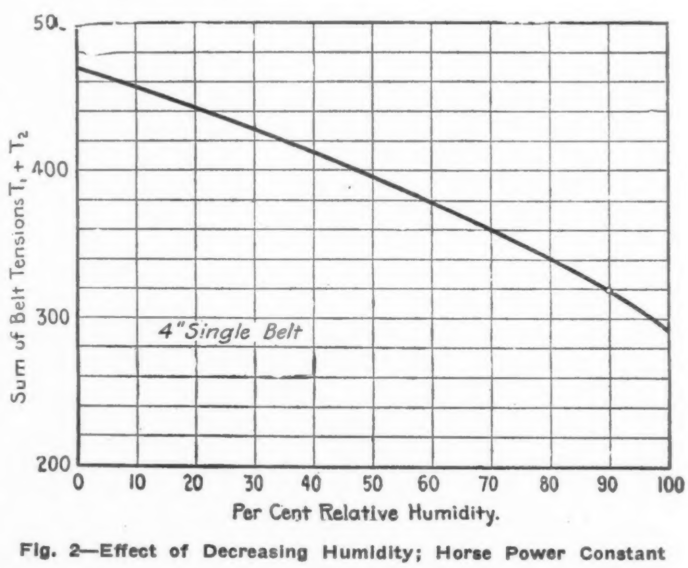


Fig. 2—Effect of Decreasing Humidity; Horse Power Constant

show similar characteristics, the same in kind, if not in amount.

In a general way it may be stated that the effect of a change in the relative humidity is greater at high humidities than at low; that the effect is shown more rapidly in single

*From a paper read before the National Association of Leather Belting Manufacturers, November 17th, 1920.

than in double belts; that an increase in the humidity shows practically immediate results, while a decrease in the humidity takes a longer time to be effective.

Much more attention should be paid to the effect of the relative humidity than is ordinarily the case. Suppose that a plant engineer who is supposed to see that belts are kept tight and working at the proper tensions, pays no attention to the weather conditions, but has the belt tightened to a tension which he calls standard.

If such an adjustment was made when the relative humidity was 20 per cent and a subsequent change in the weather conditions produced a relative humidity of 90 per cent, while the power to be transmitted remained the same, the sum of the belt tensions $T_1 + T_2$ must decrease. Since the difference in tensions remains the same while the sum decreases, it is evident that the ratio T_1/T_2 must increase. Fig. 1 shows this variation quite clearly, and at the higher humidities this ratio reaches a value where the belt is in great danger of slipping.

On the other hand, suppose that the belt was set to standard conditions when the relative humidity was 90 per cent and subsequently the atmosphere dried. The belt would then become far too tight, not only working at too high a stress, but also producing excessive pressure on the bearings. Fig. 2 shows this effect very clearly.

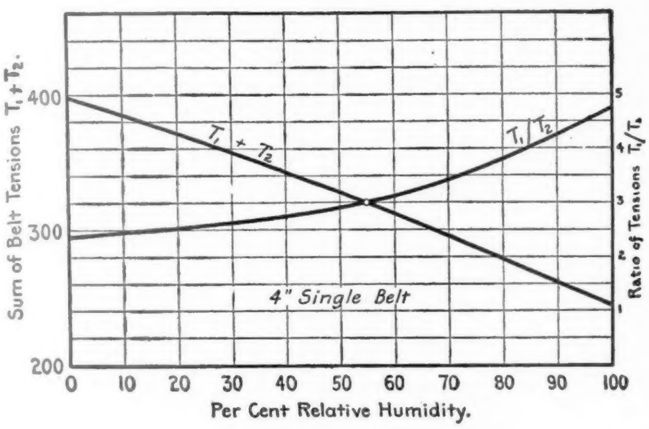


Fig. 3—Effect of Change of Humidity from 55 Per Cent; Horse Power Constant

If care were taken to allow for the effect of a change of the relative humidity, or if the adjustment were made when the humidity was 55 per cent, then no change of humidity that would occur would either tighten or slacken the belt in a degree that would be likely to give any trouble. Fig. 3 shows the effect on both the ratio and the sum of the tensions.

All of the preceding tests were made at a temperature of 70 deg. F., and it should be noted that the higher humidities are apt to occur at temperatures above 70 deg. F. and the lower humidities below 70 deg. F.

In conclusion, it may be stated that if a belt drive can be fitted with a spring or gravity tightener, so called, a load probably 50 per cent greater can be carried without danger of stretching the belt, slipping or excessive pressure on the bearings.

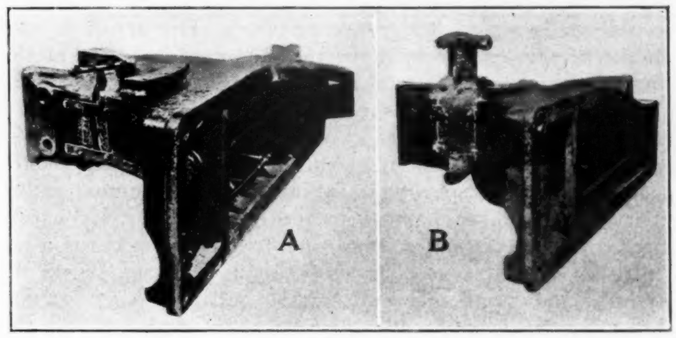
Casting Locomotive Frames in Small Units.—In order to overcome the difficulties of casting locomotive frames of unusual length and other long sections, the Metal & Thermit Corporation, New York, recommends that these be cast in shorter units and these units thermit welded together. By using this method small foundries can undertake the work. The number of parts to be welded will depend on the size of the foundry and available mold and pattern facilities.

An Air Compressor Repair

The connecting-rod of an air compressor, one of two units operated at the Erie Railroad shops, Susquehanna, Pa., for supplying air pressure to the pneumatic tools, recently snapped in two, causing one end of the rod to fly around into a wedged position and exerting such a strain on the machine that the hollow cast-iron back frame of the bed plate broke off.

The cross section of the hollow casting at the point of fracture measured about 8 in. by 6 in., the thickness of two opposite walls being 3 in. and the other two opposite walls only ⅞ in.

A new bed plate was ordered, but it was impossible to get it delivered in less than 60 days. As the idleness of this air compressor cut down the compressed air supply over all the shops 50 per cent, the operators decided to make a Thermit weld. In welding the casting, the bed plate was laid on its side and the broken sections were lined up by means of bolted straps, as shown at *A* in the illustration. These straps were left on and welded in with the metal comprising the weld. Three hundred pounds of cast-iron Thermit were used and the welded bed plate was returned to service. The appearance of the plate immediately after welding is shown at *B*.



Air Compressor Bed Plate Before and After Welding

Locomotive Cylinder Welding*

One of the most costly repair jobs on locomotives is replacing broken cylinders. A locomotive cylinder is a complicated core casting, weighing two or three tons, which requires careful fitting to the boiler, frame and opposing cylinder to insure alinement. If so badly cracked by any cause that replacement is required, the job involves not only a new cylinder but fitting in place, which work may keep the locomotive out of use for several weeks. Thus, the loss of service in a busy period may be a greater item than the actual cost of the new cylinder and the labor. Hence the importance of a process which enables a broken cylinder to be restored to service in the shortest possible time. This the railway shops have in oxy-acetylene welding.

A common cause of cylinder fracture is carelessness in closing the cylinder cocks and trapping water between the piston and the head. A slug of water is practically incompressible and when caught between the advancing piston and the head something must give way. Often the cylinder head is broken into fragments and the flanges ripped off. Breaking piston rods also wreck cylinders frequently. Another cause less frequent, but from which many locomotives suffer in cold weather, is freezing of water in the cylinders which crack by the expansion of the ice or are fractured when the attempt is made to move the locomotive. Head-on collisions add their quota of cylinder repair work.

The secrets of successful cylinder repair with the oxy-acetylene torch are proper preparation, preheating and slow

*Abstracted from the January, 1921, issue of Autogenous Welding.

cooling. There seems to be almost no limit to what can be done in restoring broken parts if care is taken to preheat to redness and to cool slowly when the job is finished. Even if the fracture is one that requires the cylinder to be removed in order to work the molten metal in a level position the saving is still substantial as the time needed for the welding and replacement is much less than that required to supply a new cylinder and to fit it in place.

In the course of cylinder welding, James Causey, cylinder repairman at the Wabash shops, Decatur, Ill., has developed a method of preheating which is a departure from the methods commonly used. Mr. Causey formerly followed the practice of building a firebrick wall around the cylinder to be welded, but in succeeding jobs such parts of the wall as could be dispensed with were removed. The result is, that at the present, no firebrick whatever is used for heat retaining. Asbestos paper extending entirely around the side walls or above the cylinder is employed instead. A large wire basket is placed below the cylinder to hold charcoal, and to the end of each cylinder, extending half way up, is bolted a thin plate to act as a retaining wall for the charcoal within the cylinder. The charcoal in the basket and cylinder are fired and more is added from time to time as it burns away until the desired degree of preheating is obtained. Then the cylinder plates are removed and the burning fuel hoed out. After the welds are made the plates are replaced and the charcoal is also added in quantities sufficient to retain the heat in the cylinder.

Driving Box Grooving Device

Grease grooves in driving boxes are ordinarily cored or chipped but there are disadvantages to either of these methods. Cored grooves may sometimes contain foreign matter which will cut the journal and, if not, the grooves may be greatly reduced in size or entirely eliminated due to wear and reboring of the boxes. Chipping, on the other hand, is an operation which requires considerable time and gives more or less unsatisfactory grooves due to irregularity and lack of sufficient depth.

A device for milling oil grooves in driving box crown bear-

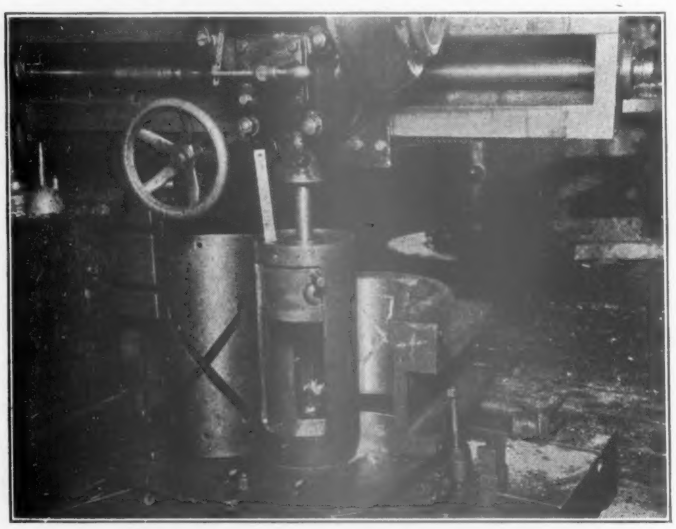


Fig. 1—Grooving Device with Master Plate Removed

ings has been developed and used with considerable success for this work. A general view of the device is shown in Fig. 1, and details of construction in Fig. 2. Referring to Fig. 2, the device consists of a base plate *B* into which is firmly fastened the hollow vertical post *C* which has two large portions of its cylindrical surface cut away as shown. The moving part of the fixture consists of a right angle gear driving an end mill and guided by means of master plate *D* and control pin *E*.

In operation, the mechanism is clamped to the base of a radial drill which furnishes power to revolve the end mill *M* through the arbor *F*, bevel gears *G* and *H* and shaft *N*. Pinion *I* and gear *J*, arranged to mesh with rack *K*, control the feed of the tool in to the required depth. It is held at that depth by a ratchet arrangement on flange *L* (not shown). Since the end mill is guided entirely by the master plate, it is evident that grease grooves in any desired size of driving box

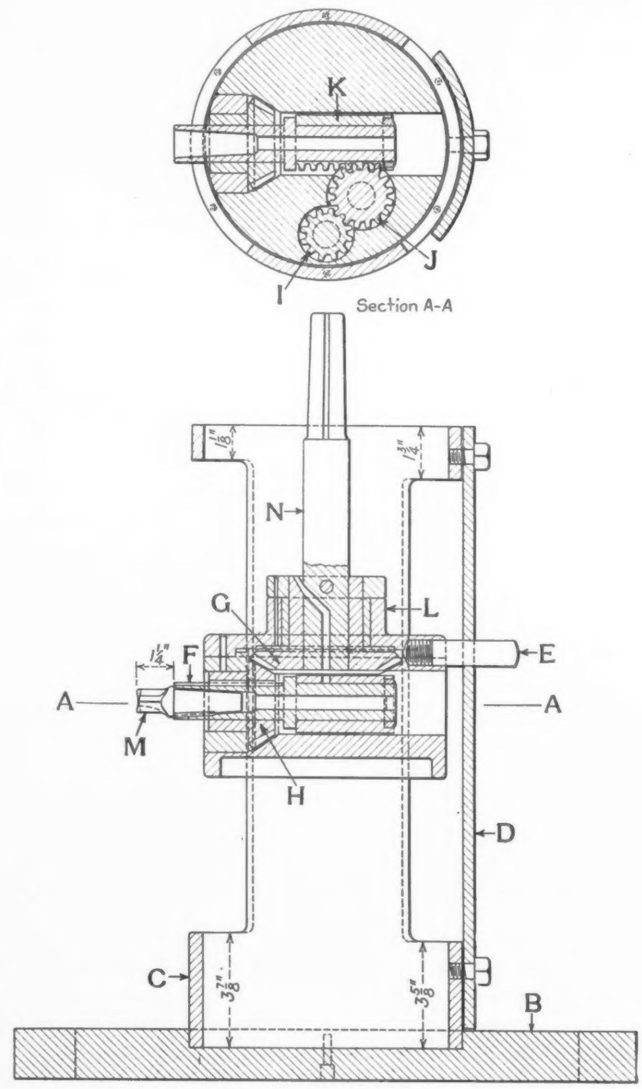
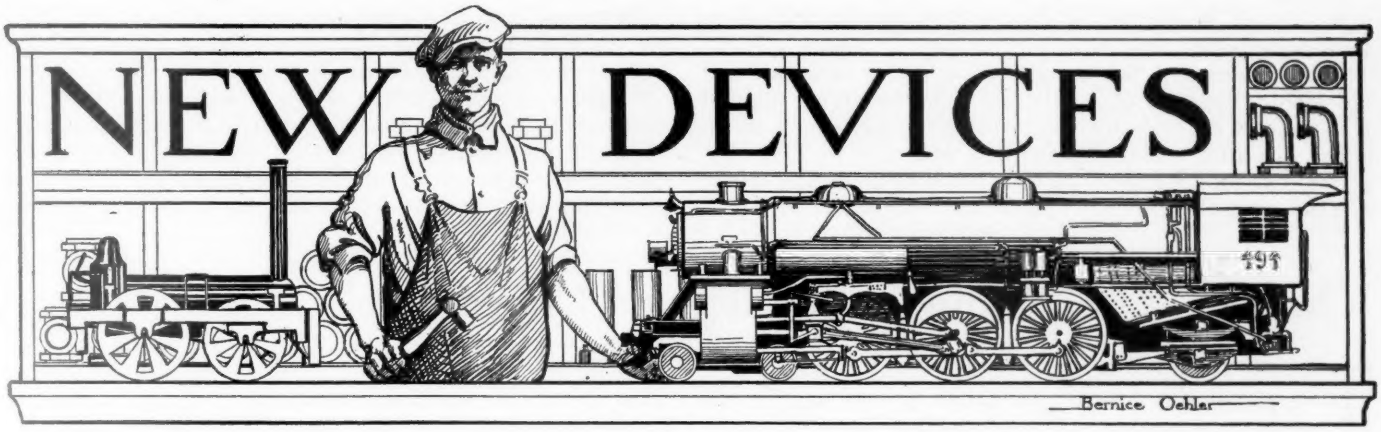


Fig. 2—Details of Driving Box Grooving Device

can be milled by providing the necessary master plate. In setting up, the driving box is slid onto the base plate and clamped so that the axis of the grooving device coincides with the center of bore of the box.

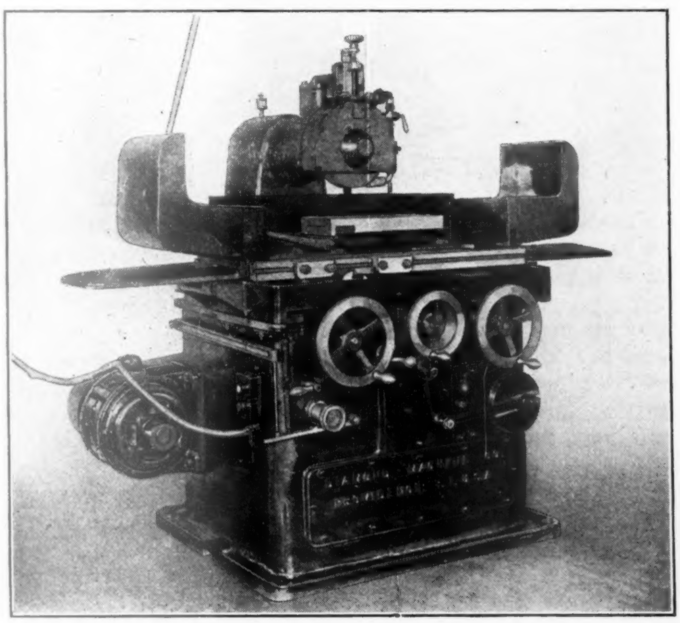
To summarize briefly, the device consists of a right angle gear box driving an end mill and guided by a master plate while the spindle of the drill is fed down. Starting at the top of the slot, the end mill is fed down, care being taken to guide it over the crossing of the slots. Then returning to the center, it is fed up and down to complete the diagonal slots.

The Allegation that railroad managers sent engines and cars for repair to outside shops in order to put "honest graft" into pockets of personal friends is proved by facts and figures to be totally false. If railway shop employees would do more work they would get more work.—*Forbes Magazine* (N. Y.)



Small High Duty Surface Grinder

RIGIDITY of construction and ability to remove metal quickly are features of the new Type C surface grinder, made by the Diamond Machine Company, Providence, R. I. Work 10 in. wide, 24 in. long and 8 in. high can be ground. One of the unusual features of this grinder is the casting of the wheel spindle head integral with the vertical column. The combined column and head rather than the head alone is adjusted up and down for different thicknesses of work. The mass of this large column added to that of the head itself is responsible for much of the improvement in the quality of the work produced.

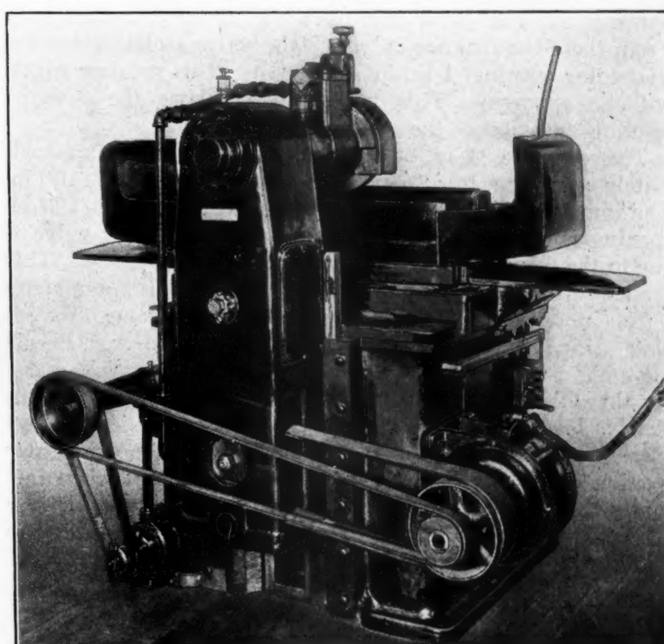


Diamond Type C High Duty Surface Grinder

Another feature closely connected with the above is the construction of the main spindle bearing nearer the grinding wheel. This is a composite ball and plain bearing which combines the advantages of both types without the defects of either. The rear end of the spindle is also provided with a ball bearing. The driving pulley is between the two spindle bearings and nearer the rear bearing so that any vibration of the driving belt cannot produce corresponding vibrations in the spindle itself. Moreover, the spindle between bearings is 2¼ in. in diameter so that flexure vibrations are avoided entirely.

The hand wheels for the three adjustments are arranged side by side at the top and front of the base and are placed symmetrically with reference to the center line of the machine. The left hand wheel for longitudinal travel moves the table about 2 in. per rev.; the center wheel moves the table transversely (in or out) .500 in. per rev., and the right hand wheel raises or lowers the wheel head (with column) .100 in. per rev. The outer edges of the rims of the two latter wheels have graduations for each thousandth of an inch so widely spaced that the operator can readily split the thousandths into tenths. Ball thrust bearings are used on both the horizontal and vertical adjusting screws. Careful arrangements of piping, guards and troughs assure an ample supply of coolant which stays where needed and does not spatter over the machine and floor.

The ways for all three directions of travel are completely covered by metal guards to prevent injury from abrasive dust or gritty water. Longitudinal travel of the table is accomplished by a train of belt driven gears and reversal is effected by a single shifting belt. A simple though novel device insures a complete shifting of the belt at each end of the stroke. A "stop trigger" is provided and a momentary pressure of the finger upon this trigger will stop the table at the completion of any stroke already begun. A clutch connected



Rear View of Grinder Showing Drive Arrangement

with the left hand wheel will stop the table instantly at intermediate points.

The transverse of "in and out" table feed is automatic and adjustable from .001 in. to .020 in. The feed takes place at both ends of the table travel and can be adjusted to move in either direction. There is an automatic stop for this feed which prevents overtravel and can be set to disengage at any desired point.

With the Type C grinder, the usual sliding toothed clutch for reversing has been eliminated which makes possible heavier cuts. A cut .234 in. deep and 1/16 in. wide, or a total cross section of .0150 sq. in., has been taken. It is stated that a pound of metal per minute can be removed with this machine. This high rate of cutting makes this grinder well adapted for production work on parts up to the maximum size that can be handled.

Regulating Valve for Liquid Fuels

THERE are many types of liquid fuels and each type is found in an almost indefinite number of grades, nor do these various grades run absolutely uniform. It is, therefore, necessary to use some sort of regulating valve which will compensate for the wide difference in liquid fuels and deliver to the burner a constant flow of fuel of varying viscosity and only in sufficient quantity to secure complete combustion. A valve designed for this purpose and known as the Rigby liquid fuel regulating valve has been placed on the market recently by Baily-Lewis, Inc., Pittsburgh, Pa. This valve has been tested and used with good success during the last two years at the Farrell Works of the Carnegie Steel Company.

As shown by the cross-sectional view, the fuel enters at the opening *12* and passes down through the stop-cock *3* into the trap *8*, where any sediment or heavy particles of fuel settle. The fuel then passes easily through the triangular opening in the valve seat *21* to the nozzle or burner.

The vital feature of the valve is the triangular aperture in the valve seat beveled back from the face and the sliding, shearing valve running in a groove cut in the face of the seat. A top view of the valve seat and triangular opening and a sectional view through the valve seat *20*, triangular opening *21* and valve are included in the illustration *4*. From these the manner in which the valve slides across the triangular opening, 1 in. long by 1/8 in. at its greatest width, will be apparent. This movement regulates the flow by opening and closing the aperture.

The area of a 1/8-in. orifice is .0123 sq. in., being approximately equivalent to a 1/2-in. needle valve open just 1/100 in. The impossibility of passing liquid fuel through a 1/100-in. opening is apparent. The superiority of the Rigby valve is due to the triangular shaped opening in the valve seat. This shaped orifice can have an opening of 1/2 in. against a 1/100-in. opening on a needle valve to give the same approximate orifice area, as shown in the table. Moreover, a needle valve has a wide seat which allows sediment or particles passing through the valve to impinge on the seat, thereby completely clogging the valve. The Rigby valve has its smallest aperture at the seat where the fuel enters the triangular opening and is beveled off as shown at *30*, so that when fuel passes through the aperture it must pass into the outlet for burning; it cannot stop as the beveled opening gives no opportunity for impingement.

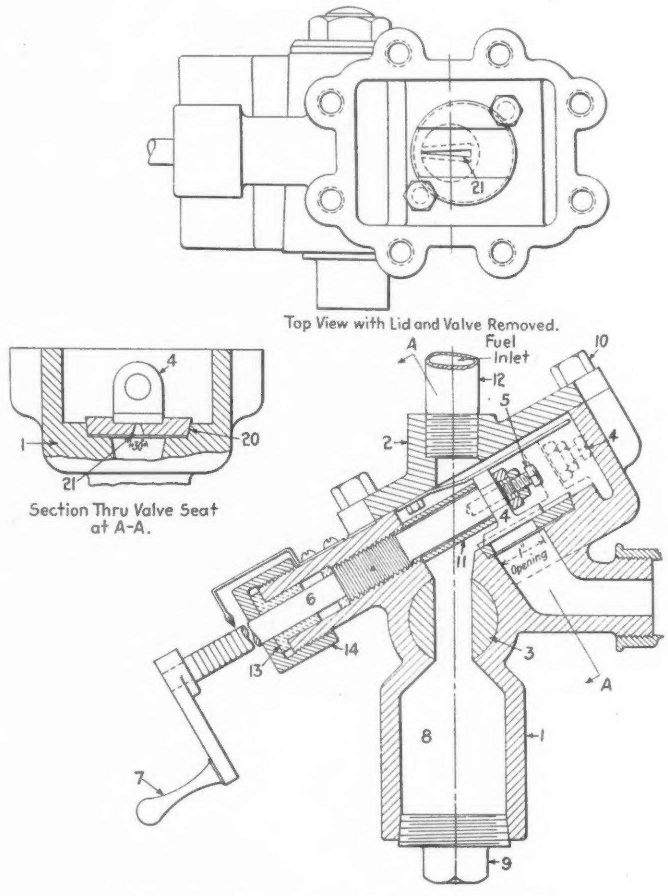
TABLE OF AREAS OF RIGBY VALVE OPENINGS

Travel of Valve	Area
1/8-in.	.00097 sq. in.
1/4-in.	.0039 sq. in.
3/8-in.	.0087 sq. in.
1/2-in.	.0156 sq. in.
5/8-in.	.0243 sq. in.
3/4-in.	.0351 sq. in.
7/8-in.	.0477 sq. in.
1-in.	.0625 sq. in.

If sediment should lodge in the opening on the seat, it can be cleaned off by turning the handle of the valve *7*, thus closing the valve. The stem of the valve is threaded so that one complete turn of the handle moves the valve 1/16 in. This operation immediately shears off the particle of sediment and pushes that part above the seat into trap *8*, the balance of the particle immediately passing through the triangular opening when the valve is again opened. This operation can be accomplished in a few seconds and the valve can be reset to give the same opening.

The trap *8* can be cleaned in a few minutes without stopping the flow of fuel through the valve, by turning stop-cock *3* and removing the plug *9*.

The lock-nut arrangement makes it possible to set the valve for any required quantity of fuel necessary. It also



Details of Rigby Liquid Fuel Regulating Valve

provides a guarantee against waste of fuel. The installation of the valve from a safety point of view is highly important, as explosions due to leakage are almost an impossibility. It is stated that savings of five to 15 per cent are possible by using the Rigby regulating valve. The valve is manufactured in sizes suitable for various conditions, with two standard sizes; namely: type "A" with 1-in. valve travel; and type "B" with 1/2-in. travel.

Duplex Mono Flue Gas Analyzer

A NEW type of instrument designed to make automatic analyses of flue gases and to record both CO_2 and combustible gases has been developed by the Mono Corporation of America, Buffalo, N. Y. The instrument, which is known as the Duplex Mono Gas Analyzer, is intended to give a more reliable indication of the efficiency of combustion than can be obtained by the use of an instrument

Automatic Analyzer for Recording CO_2 and Combustible Gases

recording CO_2 alone. To show the necessity for greater refinement in flue gas analysis, it is pointed out that an increase of one per cent in the combustible gases may decrease the efficiency of combustion over six per cent. The percentage of CO_2 at which combustible gases begin to form, varies considerably from time to time, even in the same furnace. Occasional tests with hand instruments to determine the presence of CO do not give sufficient data to insure proper combustion conditions, and effective combustion control can be established only by continuously recording the percentage of CO_2 as an indicator of the amount of excess air present and also detecting and recording the presence of combustible gases, either CO, CH_4 or H_2.

The Duplex Mono is designed to detect the presence of combustible gases in the flues immediately upon their appearance and to record accurately the percentage of CO_2 at that particular time. The chart shown herewith is a diagram made by one of these double recording instruments. The lower contour of the diagram represents the percentages of CO_2 present at all times. The lighter areas indicate the presence of combustible gases. The height of the lighter areas indicates roughly the proportion of combustible gases present, but is not intended as a measure of the actual percentage and is on a larger scale than the CO_2 record.

The apparatus which is shown in the illustration is driven by water pressure of about 10 lb. per sq. in. Before entering the instrument, the gas samples from the flue are pulled through a filtering system, which removes all soot and dirt. They are then drawn into and forced through the apparatus by a mercury piston. There are no mechanical valves, such functions as these ordinarily fulfil being performed by various kinds of mercury seals, traps and similar arrangements.

Samples of gas are forced alternately through two routes, one leading directly through a caustic potash tank where CO_2 is absorbed, and the other first through an electrically heated furnace wherein the combustible gases are oxidized to CO_2 and H_2O, and then through the caustic potash tank. Samples that are forced through the caustic potash tank only give the readings for CO_2. Those that are first forced through the electrically heated furnace and then through the caustic potash tank give readings of CO_2 plus combustible gases. The difference between any two successive readings is proportional to the amount of the combustible gases present at the time the analyses are made.

In the electrically heated furnace, the oxygen necessary to oxidize the combustible gases, CO, CH_4, and H_2 to form CO_2 (which is later absorbed in the caustic potash tank) and water (which is condensed) is usually taken from the air which is almost invariably present in flue gases, even when combustible gases are present. When such free oxygen is not available, oxygen is taken from copper oxide provided in the furnace for that purpose. The copper oxide, however, probably seldom acts as anything but a catalytic agent and need never be renewed.

Should any of the copper oxide be reduced to plain copper to oxidize combustible gases in the process of analysis, it is reoxidized by oxygen present in the flue gas samples passing through the electric furnace later.

To diminish the lag between the time when the gas leaves the flue and the analysis is recorded on the chart, small communicating tubes are used. The lag between the time that the sample is taken from the flue to the time that it is recorded by the instrument is about three minutes where the distance between the instrument and the point where the flue is tapped is about 60 ft. and the instrument is making about 40 analyses per hour.

These instruments are made to produce records covering a range of either 20, 25 or 40 per cent, according to the purpose for which they are intended. The apparatus is practically dustproof and requires only a slight amount of attention, which consists in winding the clock once a week, replacing the caustic potash solution two or three times a month, replenishing the ink supply twice a month, and putting in new rolls of recording paper once every two months.

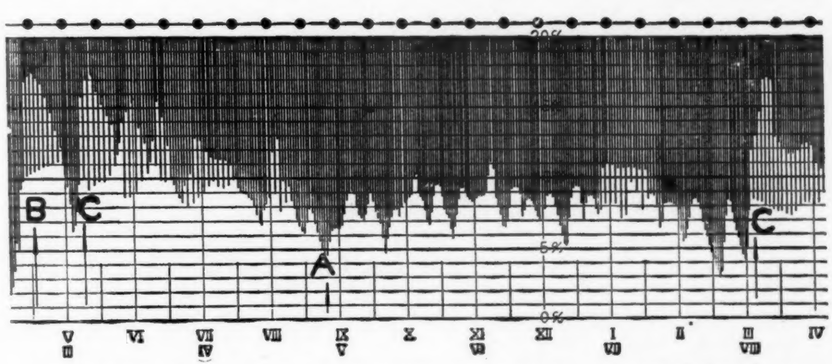


Chart from Duplex Mono Analyzer Indicating Presence of Combustible Gases

The readings indicating the presence of combustible gases are exaggerated, if anything, by the Duplex Mono. This is quite an advantage in a danger signal. The losses due to the appearance of combustible gases are much greater than the savings due to an equivalent increase in CO_2 as registered on the chart, and an exaggerated record of their presence on the chart has a favorable effect on the fireman. Since it is aimed never to have combustible gases present at any time, there would be no object in having exact records

of the percentage present when they do appear. An approximate, and preferably an exaggerated record, as made by this instrument, is all that is necessary. The CO_2 records of the machine are invariably accurate.

The utmost efficiency of combustion is attained with the highest percentage of CO_2 that can be reached in a given furnace without having combustible gases begin to appear. The higher it can be raised, the more economical is the process of combustion. Knowing its maximum from the records of the instrument, the fireman can always tell the degree to which he is approaching ideal conditions. Should combustible gases appear at a point below the critical point, he knows that his dampers, fire doors, or the fire itself needs immediate attention, which experience soon teaches him to give to the best advantage. The record is equally valuable for the plant executive.

Safety Locomotive Cold Water Sprinkler

ONE positive advantage and three negative advantages are claimed for the locomotive cold water sprinkler, recently invented by George Dittman, roundhouse foreman of the Pittsburgh & Lake Erie, at McKee's Rocks, and placed on the market by the McKee Company, Pittsburgh, Pa. An abundant supply of water at a usable temperature is provided and the device will not discharge steam

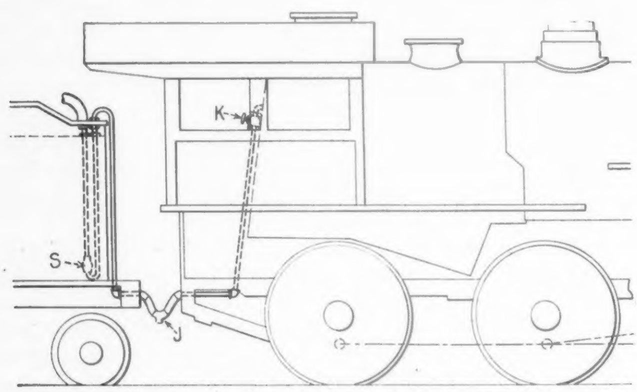


Fig. 1—General Arrangement of Dittman Cold Water Sprinkler

or hot water, cannot freeze and will not interfere with any other device on the locomotive.

The general arrangement of the sprinkler on a locomotive and tender is shown in Fig. 1, which indicates the ease of applying or removing it without draining the tank. Referring to Fig. 1, *K* is the steam control valve, *J* the automatic drain fittings and *S* the sprinkler valve proper. Valve *S* is shown more in detail at *A*, Fig. 2. When the operating valve is open, steam passes through the piping to the underside of the sprinkler valve, expanding through the nozzle and drawing water through the small holes indicated. Part of the velocity of the steam is imparted to the water which is delivered in a continuous stream to the sprinkler hose. The location of the valve in the bottom of the tank assures an ample supply of cold water and eliminates danger of discharging steam or hot water and scalding the fireman.

The automatic bronze drain valve shown at *B*, Fig. 2, is placed at the lowest point in the steam supply pipe or hose and, as shown in the illustration, remains open except when steam pressure is applied, thus preventing freezing.

The application of the Dittman cold water sprinkler is easily made. A hole 1¾ in. by 3½ in. is cut in the top of the tank at a convenient point; two ⅝ in. bolt holes, spaced 5 in. on centers, being drilled to receive the studs. Referring to *A*, Fig. 2, a return bend is made in a piece of ⅜ in. pipe long enough to reach to the bottom of the tank. The sprinkler

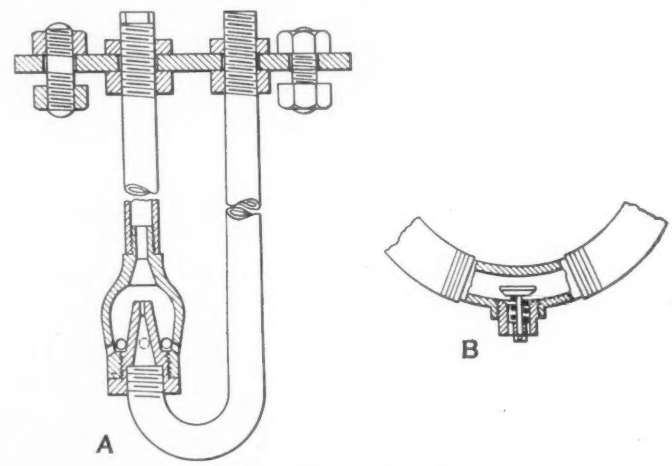


Fig. 2—Details of Sprinkler and Drain Valve

valve and cover plate are applied as shown with the return bend secured to the cover plate by lock nuts at the top and bottom. Application of the studs holds the device firmly in place. The installation is completed by applying a steam valve *K* at a convenient point on the back head and inserting the drain valve at the lowest point in the connecting piping.

A Long Life Cutting-Off Tool

Cutting-Off Tool With Long Cutting Circumference

A NOVEL cutting-off tool with a cutting circumference of over 300 deg. has been developed by the R. G. Smith Tool and Manufacturing Company, Newark, N. J. This cutting-off tool, as shown in the illustration, is made so that clearance is maintained throughout the entire cutting circumference by gradually tapering down the thickness of the cutting edge. This gives the tool ample side clearance rake, the other clearance being secured by grinding when sharpening.

This tool is used in the patented Smith tool holder, being held firmly in place by tightening up the set screw shown with a small hexagonal wrench. On account of the ease of sharpening and long life of this cutting-off tool, it is adaptable to use in automatic screw machines and turret lathes, as well as in hand lathes.

Centrifugal Pump for Cooling Compounds

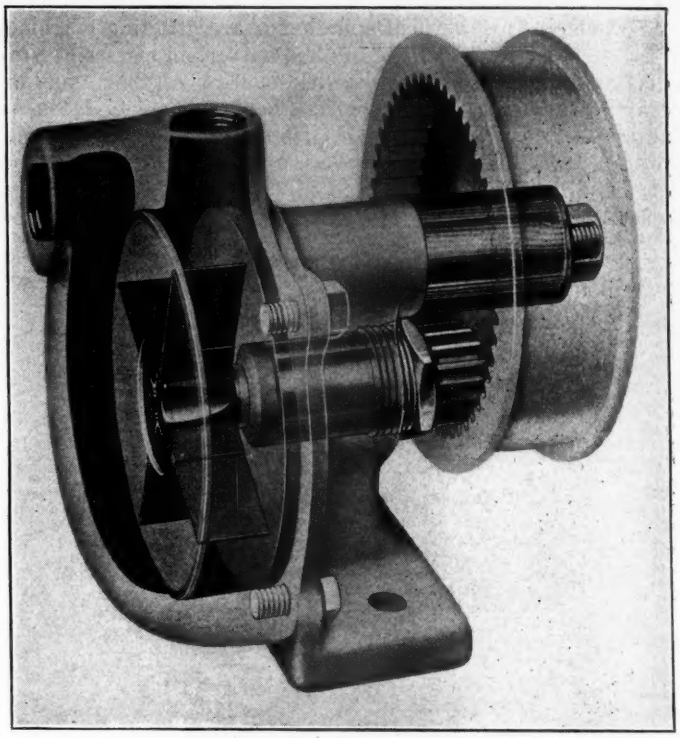
FOR delivering oil or water to drill presses, lathes, tapping machines, centering machines, screw machines, etc., whether the machines are running forward or in reverse, a two-way centrifugal pump, as illustrated, has been developed by the Ross Manufacturing Company, Cleveland, Ohio.

The Ross pump is designed to deliver a flow of liquid from the same outlet regardless of the direction of rotation of the impeller blades and from this ability to reverse instantly comes the name "two-way" pump. With machines which run in both directions such as screw machines, the pump must work in two ways, otherwise the machine will be without cooling compound when running in one direction. Where a battery of machines is cared for by a single pump, a reservoir is placed in the main distributing line with an overflow, thereby providing gravity feed for normal use, and where pressure is required the overflow is plugged.

The Ross pump is light, compact and neat, and is said to give a large and constant volume of any liquid, bringing the stream to the work without pressure. If pressure is required, however, the outlet nozzle is reduced in size and the pump speeded up. No priming is needed after the first time.

The pump is constructed with oilless bearings and graphite-asbestos packing and no bearings or gears come in contact with the cooling compound. This feature is important as steel chips are bound to mix with the compound and the bearings or gears cannot be expected to last long with steel chips being constantly ground through them.

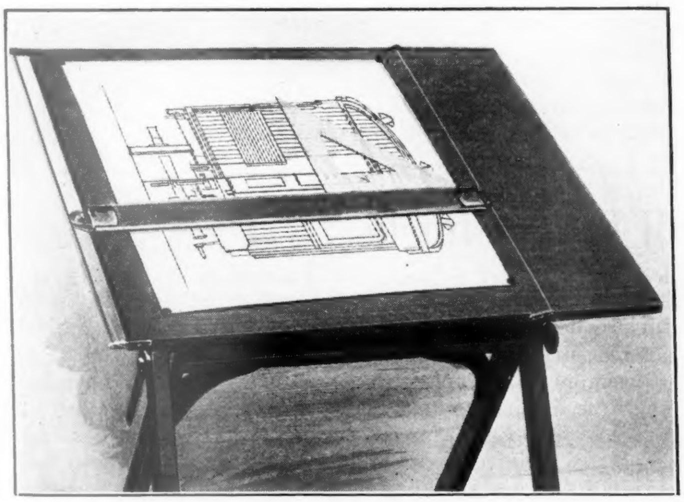
The impeller is composed of four light pieces of vanadium spring steel and the design is such that there is no end thrust. The pump can be mounted with the base in any one of four positions and is assembled with four hexagon-head cap screws, which simplifies disassembling. The gear ratio is four to one, giving a high impelled speed when belted to a slow pulley.



Ross Two-Way Centrifugal Pump

Precise Parallel Ruling Attachment

MANY advantageous features are combined in the parallel ruling attachment developed recently by the New York Blue Print Paper Company, New York. This device may be applied to any drawing board, large or small, and there are no cords or wires on the surface of the board to interfere with the work. In addition, all cords on the under side of the board are eliminated and metal parts are so designed that the drawing board can rest on a table or other piece of furniture and be moved from place to place without scratching the surfaee.



Precise Parallel Ruling Attachment

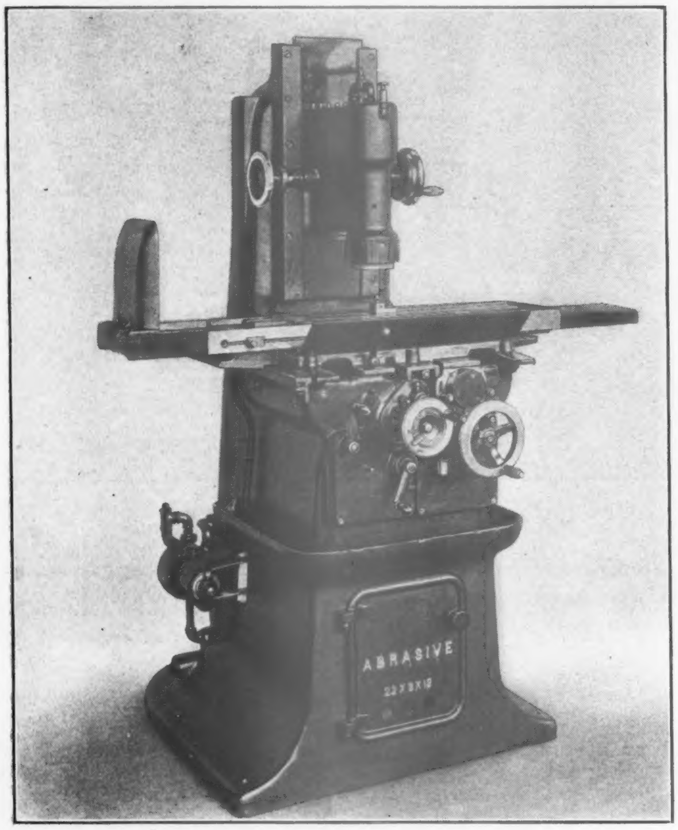
All metal parts of the attachment are made of aluminum and will not rust. Two plates are provided, one with a double pulley and the other with two small pulleys, to be applied to the ends of the straight edge. Four metal brackets are applied to the corners of the drawing board and a small metal grip is provided to hold the cord which guides the straight edge firmly.

The straight edge may be of any length desired, regardless of the size of the board, as shown in the illustration. In this case, tools, ink, etc., may be placed on the board at the right of the attachment without interfering with its operation. The double pulley acts as a T-square head since it is provided with a shoulder for that purpose and the cords running parallel are hidden in the straight edge. The pulleys are firmly and accurately attached to the straight edge and are given a careful test at the factory before shipment to insure perfect alinement.

An additional advantage of the Precise parallel ruling attachment lies in the fact that the straight edge can be simply and quickly adjusted to any angle desired. The attachment is stated to be accurate in every detail, convenient to manipulate and an efficient device for drawing room work. It is furnished complete in lengths varying from 24 to 60 in. and can be fitted with straight edges having crystalloid transparent lined, mahogany lined, and hardwood lined edges for various classes of work.

Vertical Spindle Surface Grinding Machine

FOR several years there has been a demand for a small but sensitive vertical spindle surface grinding machine, not only for tool room use but for certain classes of production work, as for instance the squaring of shaft ends on centres, surfacing of small pieces held by magnetic chucks and re-sharpening pilot dies. Heretofore, the grinding of pilot dies has necessitated the use of a much larger machine of the horizontal spindle type in order to secure the large wheel diameter required to clear the pilots. By using the

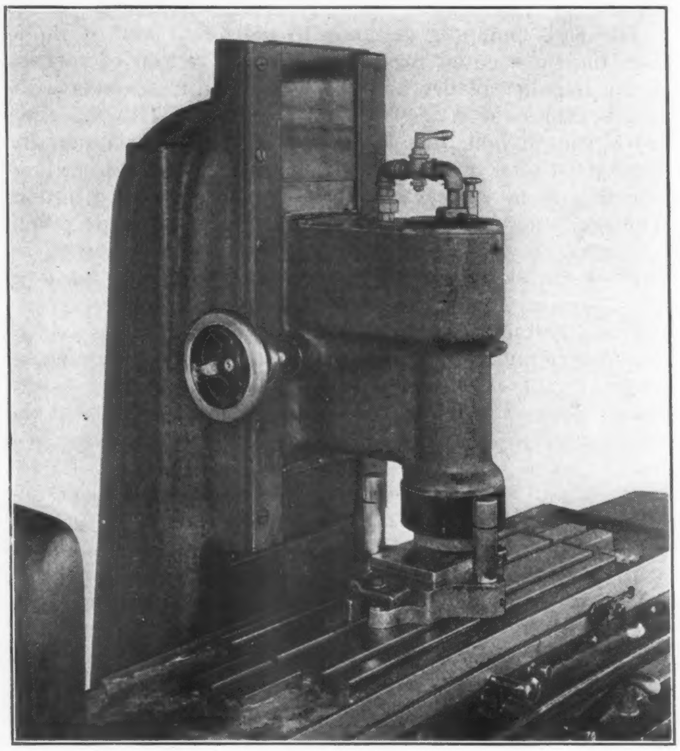


Sensitive Vertical Spindle Surface Grinder

cupped wheel the cutting edges of the die are left sharp, whereas, with the disc style of wheel these edges are more or less "dubbed" over. The grinding time is also materially reduced.

The machine illustrated has a capacity of 22 in. longitudinal feed, 8 in. transverse feed, both automatic, and 10 in. hand vertical adjustment. The wheel spindle is massive and carried on radio-thrust ball bearings. All of the high speed shafts are likewise carried on ball bearings. Wheels up to 5 in. in diameter can be used.

The adjustment of the wheel head is by means of a screw



Grinder Used for Sharpening Pilot Die

which is actuated by a worm and wheel. Two hand wheels are provided, one for fine feed being graduated to .00025 in. and one for rapid movements having an acceleration of 3 to 1. The gear case for the operating table and cross feed is a self-contained unit in which the gears and clutches run in a bath of oil.

All belts are enclosed, also all dangerous moving parts, so that the safety of the operator is assured. All bearings are carefully guarded against the admission of dust or water. The machine, which is made by the Abrasive Machine Tool Company, East Providence, R. I., can be equipped with countershaft or concealed motor drive. Ample provision is made for use of water or a cooling compound.

Pilot Bar and Drill Press Chucks

THE pilot bar type of chuck illustrated, which was developed recently by the Frontier Chuck & Tool Company, Inc., Buffalo, N. Y., was especially designed for work requiring piloted tools. Referring to Fig. 1, it will be seen that the air cylinder and the chuck are one complete unit and that the air source is at the back of the outer tube, the air being piped through the spindle of the machine on which the chuck is mounted. A revolving air box on the rear end of the spindle makes an ideal connection to the air valve. A tube is screwed into the piston which allows a pilot bar of any desired length to enter without interfering with any other part of the chuck.

Wedge spindles of the circular type and with flat inclined surfaces, which rest against the ends of the levers are held in place but free to revolve on the face of the piston by special nuts. The wedges, one for each jaw, rest against a similarly tapered surface on the end of the lever that is pivoted at the opposite end and pinned to a jaw at the center. Therefore, when the air is admitted to the cylinder the piston and the wedge spindles are forced forward, causing the levers to swivel on their fulcrums and bringing the jaws toward the center of the chuck. When the air is turned off, springs force the piston and jaws back to their original positions. It will be noted that the pilot bar is guided by the pilot bushing which is screwed into the face of this chuck and that the outer pilot tube has no movement whatever.

The drill press chuck, shown in Fig. 2, was developed for application on drilling machines and other machines where

the chuck does not revolve. The chuck is provided with holes for bolting to the table of the machine. Its operation is similar to that previously described with the exception that the air is admitted at one side of the cylinder instead of the back. Due to the opening running clear through the center, danger of chips working into the operating mechanism is eliminated. Also, the base is raised on four legs about one inch high which allows the operator to rake out any chips that might accumulate by falling through the opening in the center. Both chucks are made with either two or three jaws, manufacturing or adjustable type, and in sizes, 10 in., 12 in., 15 in. and 18 in.

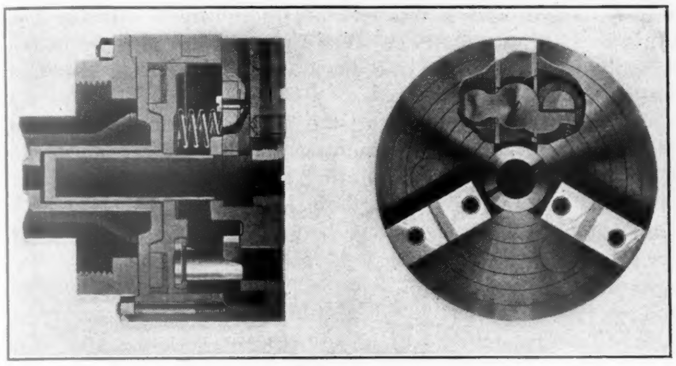


Fig. 1—Lavoie Pilot Bar Pneumatic Chuck

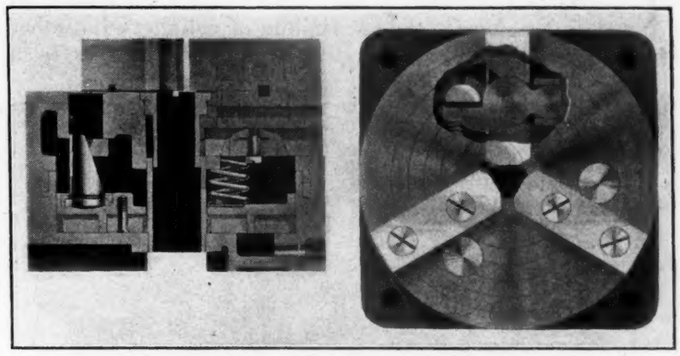


Fig. 2—Pneumatic Chuck Used on Drilling Machines

Die Heads for Railroad Shop Use

ALTHOUGH on the general market for several years, it is only recently that H & G automatic self-opening die heads, manufactured by the Eastern Machine Screw Corporation, New Haven, Conn., have been introduced for use in railroad machine shops. The range of sizes of die heads has been extended to cover the requirements of this work and two styles are provided designed to handle almost any threading job in the railroad field. Style *A*, a phantom view of which is shown in Fig. 1, is of the rotating type for use on automatic screw machines and bolt threaders. Style *C*, illustrated in Fig. 2, is of the stationary type for use on turret lathes, hand screw machines, etc.

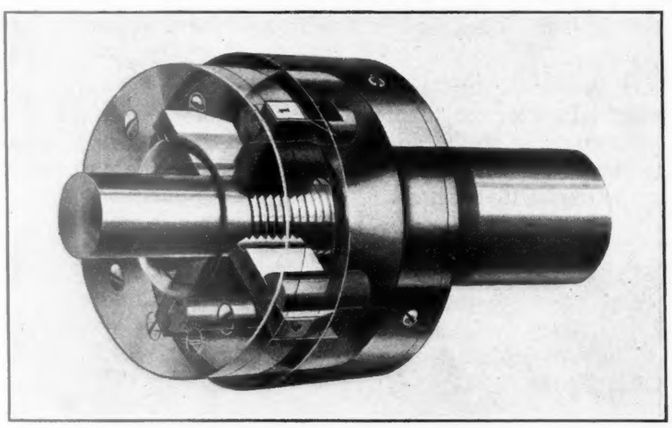


Fig. 1—Phantom View of Style A, H & G Die Head for Use on Automatics

The working parts of the die head are plainly illustrated and the same general working principle applies to both styles. The chasers slide in slots that are accurately ground and fitted. Sliding cams hold the chasers rigidly to the exact diameter desired and practically eliminate the possibility of faulty threads. In the design of these die heads every effort has been made to secure a high degree of workmanship, assuring parallelism and accuracy of leads in all threads cut.

All parts of the die heads are hardened, thus providing increased strength and greater wearing qualities. The heads are easily adjusted to accurate dimensions and each size will cut threads of various diameters and pitches with a change of chasers. The style *A* H & G die head is made in nine sizes for cutting threads up to 3 in. in diameter and the style *C* is made in six sizes for cutting threads up to the same size. Style *CC* is a special model made for Cleveland automatic screw machines and can be furnished in three sizes, having a maximum capacity of 1½ in.

Referring to the phantom view, the chasers are operated by cams having a positive bearing directly over the cutting edge. There are no springs used in closing the head. The cams are solidly supported by the body and the entire construction is characterized by simplicity. The chasers are hobbed, causing the threads to run true to leads and micrometer measurements. The chasers are made from specially selected high speed tool steel hardened to assure toughness, durability and long life. The chasers are interchangeable and may be used in any H & G die head of the same size, irrespective of style or date of manufacture. This feature allows a large number of sets to be carried in stock ready for prompt shipment.

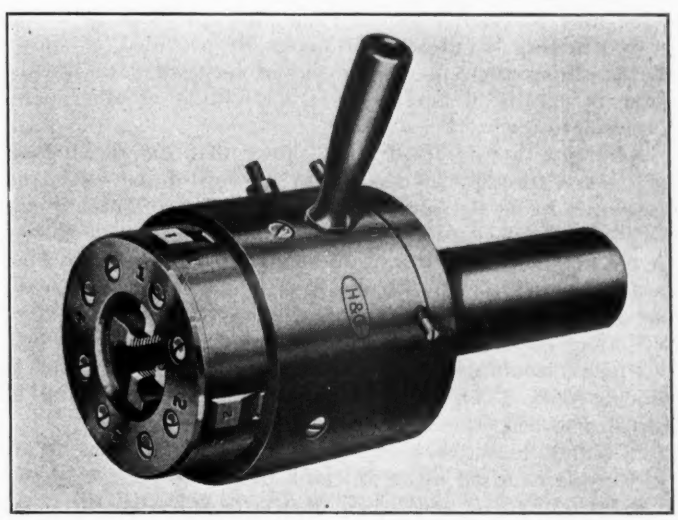
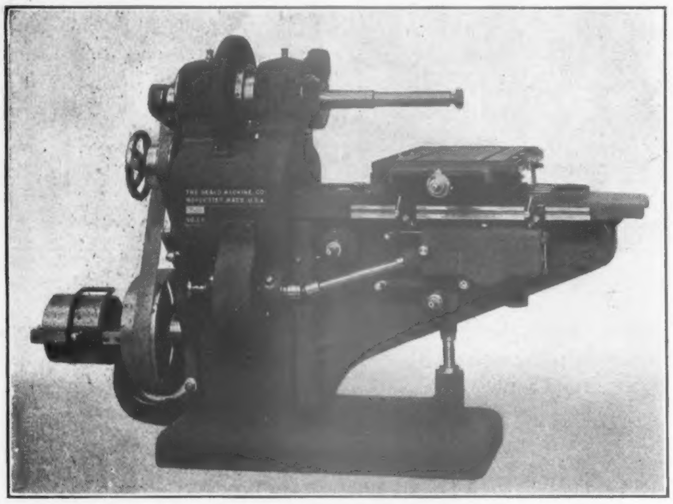


Fig. 2—Style C Die Head for Use on Turret Lathes, Hand Screw Machines, Etc.

Self-Contained Internal Grinder

THE Heald Machine Company, Worcester, Mass., has developed recently a new cylinder grinder known as style No. 55, for the re-grinding of cylinders and other internal grinding repair work. This machine differs from the Heald style 60 machine commonly used in railroad repair shops by the elimination of certain speed boxes and other expensive units. These are replaced by a drive from a single shaft on the rear of the machine. The machine is self-contained and a countershaft therefore is unnecessary. This is also an advantage since the machine may be belted directly from the main line drive and no time is required in setting up a countershaft.


Heald No. 55 Internal Grinder

In addition to simplifying the style 60 grinder, the new machine is provided with increased width for the knee and main table so that when grinding the extreme hole at either end in the larger castings, there is no undue overhang on either side. Also, the distance between the center line of the grinding spindle and the top of the cross slide table has been increased. On the style 60 machine, this dimension ranged from 4¼ in. to 7½ in. and on the style 55 machine, 7 in. is the minimum and 9½ in. the maximum. This feature is especially convenient when the machine is used for grinding holes in large castings, as is often necessary in railway shop work.

The eccentric and spindle arrangement on the style 55 machine is the same as on the style 60. As regular equipment, an arm is provided which grinds holes 2⅜ in. in diameter and over by 11 in. long; also holes 3 in. in diameter and over by 18 in. long. This arm is particularly desirable for certain classes of repair work and may be furnished in other sizes if desired. The advantages of the new style 55 Heald grinder may be summed up in the facts that it is self-contained, comparatively simple in construction and possesses a larger range and greater capacity than the style 60 machine. All of these advantages are particularly valuable for miscellaneous internal grinding work.

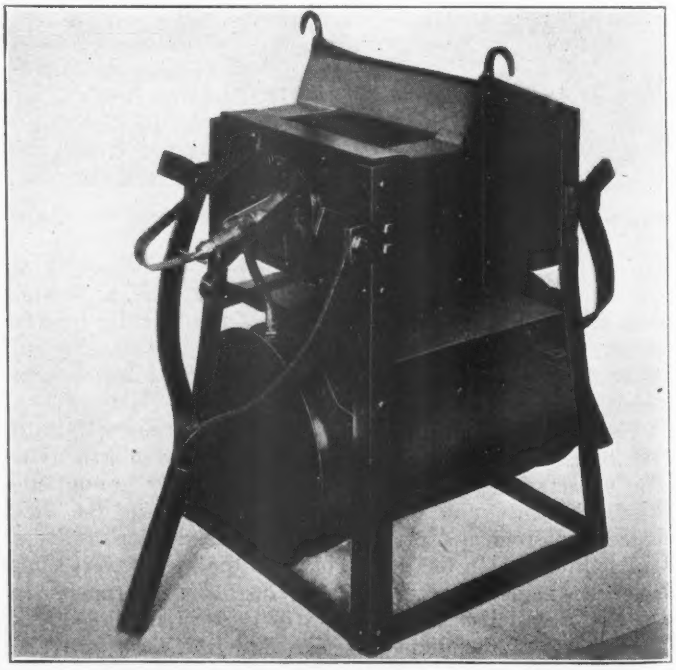
A Handy Forge for Heating Rivets

A LIGHT weight, portable rivet heating forge, which is stated to be economical and efficient in operation, has been placed on the market recently by the Norton Manufacturing Company, Boston, Mass. The forge may be readily moved from place to place by means of two folding handles. Two hooks are provided, as shown in the illustration, in case it should be desired to lift the forge by means of a crane to a scaffolding or other point adjacent to the work.

Reference to the illustration shows that the spent gases are vented through an opening in the top of the forge and pass upward away from the operator. This eliminates the necessity for the customary air curtain and is said to save in the neighborhood of 8 to 20 cu. ft. of compressed air per min. Rivets are manipulated through the top opening without discomfort to the operator and are always in plain view. No direct blast touches the rivets which are, therefore, subject to minimum oxidation. The forge may be regulated to provide only a mild soaking heat or the flame may be adjusted to keep rivets at a white heat.

A valuable safety feature results from the fact that no air pressure is required in the oil tank of this forge. A special vacuum burner is used which draws the oil from the tank, thus preventing leakage from all pipes and fittings due to pressure. The burner is simple in construction and operation, so designed as to burn low grade fuel oil or kerosene with an accurately controlled temperature. Standard fire brick are used in the forge and, therefore, it may be relined quickly and at a minimum of expense.

Starting with a cold forge, it is possible to heat rivets white hot in five minutes. The No. 2 Norton forge, illustrated, weighs 190 lb. and is 24 in. in height. It has a capacity to heat 350 ¾ in. by 3 in. rivets per hour. The oil tank has a capacity of 10 gal. In operation this forge is said to have shown an oil consumption of less than one gallon per hour and an air consumption of less than 4½ cu. ft. per min. On account of the fact that rivet forges are operated almost continuously, it is important that they should be economical in the use of fuel and air.


No. 2 Norton Rivet Heating Forge

Radial Drill Stand and Removable Drill

FOR bench drilling operations, particularly in railway tool rooms, the Hisey-Wolf Machine Company, Cincinnati, Ohio, has recently developed a tool which will be of special value. As shown in Fig. 1, the standard Hisey-Wolf portable drill of $1\frac{1}{4}$ in. capacity, which may be furnished in either the single or two-speed type, is

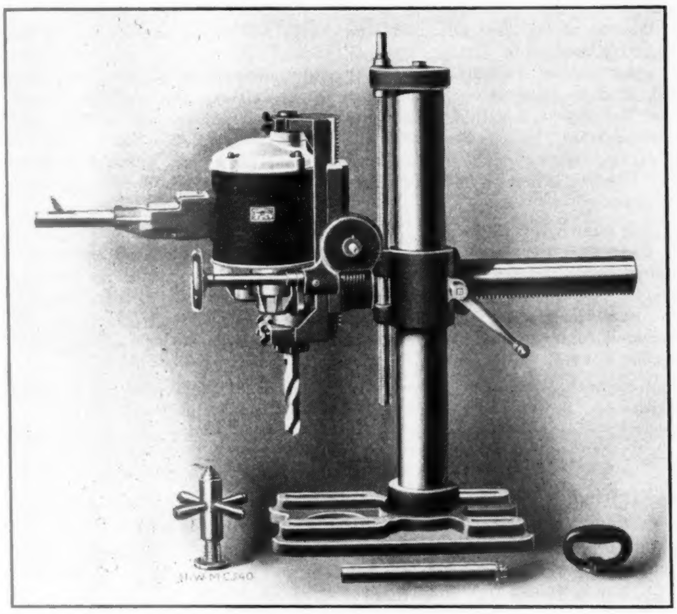


Fig. 1—Hisey-Wolf No. 3 Radial Drill Stand

mounted in a special head attached to a radial drill stand. The drill is held firmly in place by suitable clamps and is capable of adjustments, vertically and horizontally, as shown in the illustration. In addition, the drill holding head may be tilted at an angle with the base of the stand by means of the small hand wheel shown. A graduated collar facilitates setting the drill at any required angle. After necessary adjustments are made, the drill may be clamped firmly in the desired position and operation of a trigger starts the motor.

The portable drill removed from the stand is shown in Fig.

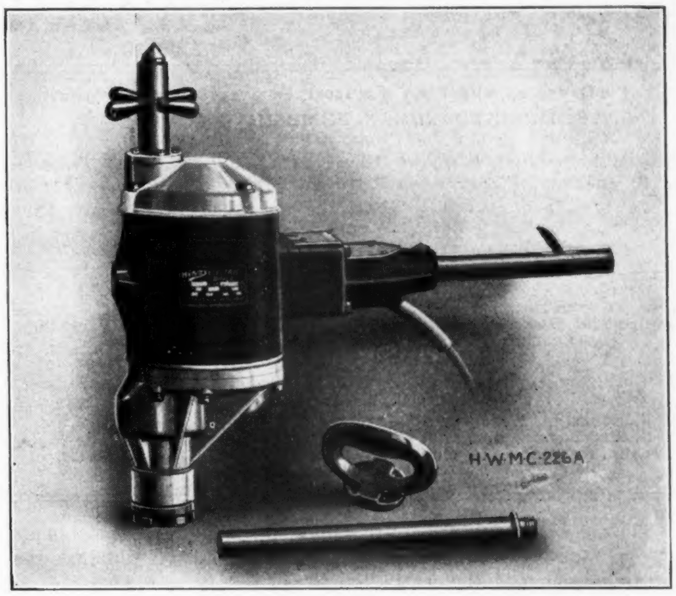
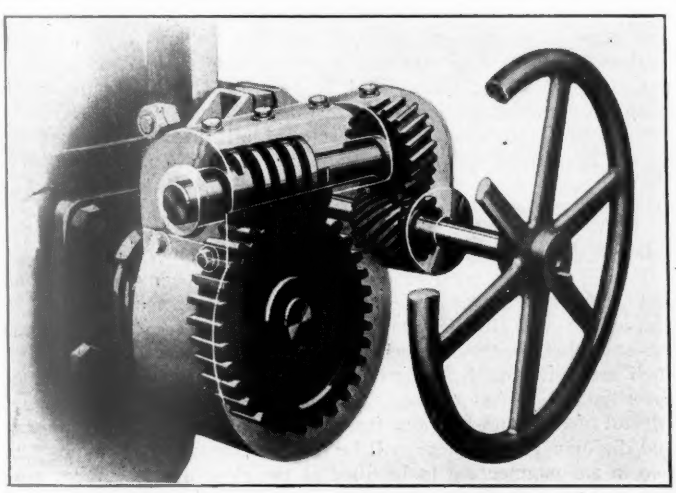


Fig. 2—Portable Drill Before Application to Stand

2. It is evident that the field of usefulness of this drill is greatly increased since it may be used either as a portable or radial drill. Suitable slots provided in the base of the drill stand may be used to bolt it to a bench or table as desired. Dimensions of the No. 3 radial drill stand correspond to types "NM" and "NNA" radial drills manufactured by this company. When the No. 3 radial drill stand is ordered separately, the full name plate markings of the make of the machine, for which the drill stand is wanted, should be given.

Helical Worm-Geared Crane Ladle

THE distinguishing feature of a new ladle designed by the Whiting Corporation, Harvey, Ill., is the fact that the gearing is mounted on the trunnion instead of on the bail. Consequently any distortion of the bail or bowl will not interfere with the alinement of the gears. The manner in which the gear bracket engages the bail is clearly shown in the illustration. A further advantage of this arrangement is that the gear alinement is not affected by wear on the trunnion journals.



Whiting Crane Ladle Tilting Mechanism

This gear combination, as illustrated in the phantom view, has the self-locking feature of worm gearing but by virtue of the balanced thrust obtained through the helical gears and the efficiency of the gearing being much higher than that of the ordinary worm gearing, the power required to rotate the ladle is considerably less. The helical gear on the hand wheel shaft meshes with a helical gear on the worm shaft. The work shaft is placed at an angle so that the worm will properly mesh with the large straight-toothed gear keyed to the trunnion. The latter gear is of cast steel; the worm and helical gears being made of forged steel. All gears have machine cut teeth. The construction of the gear case is such that it will accommodate several different ratios of helical gears, depending on the speed desired.

This new style of gearing is completely enclosed in a dust proof cover, yet is readily accessible for inspection. Small oil cups with spring caps provide ample lubrication. Crane ladles of this type are made in various sizes for both iron and steel.

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WE GUARANTEE, that of this issue 10,500 copies were printed; that of these 10,500 copies, 9,460 were mailed to regular paid subscribers, 9 were provided for counter and news company sales, 266 were mailed to advertisers, 32 were mailed to employees and correspondents, and 733 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 31,000, an average of 10,333 copies a week.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The piece-work system has been restored in two departments of the foundry of the Pennsylvania Railroad at Altoona—the cleaning room and the wheel foundry.

The Landis Tool Company, Waynesboro, Pa., has announced its intention of reducing prices, commencing March 1, 1921, on all machines, with the exception of crankshaft grinding machines. The reduction on other types will average 15 to 20 per cent.

By a fire at the Pullman repair works at one hundred and eighth street and Langley avenue, Chicago, on the morning of January 27, a freight car shop was destroyed at a loss of about $450,000. Seven new refrigerator cars and 12 Pullman sleepers were also destroyed. The fire was the result of spontaneous combustion in one of the tool rooms.

W. J. Tollerton, general mechanical superintendent of the Chicago, Rock Island & Pacific, and chairman of the Mechanical Division of the American Railway Association, has been designated as American reporter to the International Railway Congress to be held at Rome, Italy, in April, 1922, on question No. VII—Passenger Carriages.

The United States Civil Service Commission announces an open competitive examination for senior mechanical engineers, Grade 1, salaries $3,000 to $5,000. A vacancy in the Bureau of Locomotive Inspection and vacancies in positions requiring similar qualifications at salaries ranging from $3,000 to $5,000, will be filled from this examination. Applications should be made on Forms 1312, which must be filed with the Civil Service Commission, Washington, D. C., not later than March 29.

Sir Robert Hadfield, inventor of manganese steel and a leader in the British steel industry, has been awarded the John Fritz gold medal for notable scientific and industrial achievement. Manganese steel, non-magnetic, was used in the manufacture of millions of helmets worn during the war by American, British and Belgian soldiers. Award of the medal was voted unanimously by the sixteen members of the committee representing the American organizations of civil, mechanical, mining, metallurgical and electrical engineers.

Freight Cars

The Delaware, Lackawanna & Western has ordered 40 caboose cars from the Mt. Vernon Car Manufacturing Company.

The Louisville & Nashville has ordered 1,500 box cars, and 100 40-ton stock cars from the American Car & Foundry Company; 500 box cars from the Mt. Vernon Car Manufacturing Company; 300 40-ton coke cars, and 300 55-ton gondola cars from the Chickasaw Shipbuilding Company.

Shop Construction

ATCHISON, TOPEKA & SANTA FE.—This company has awarded a contract for the construction of a one-story brick addition to its machine shop at Argentine, Kan., to Jerome Moss, Chicago, at an approximate cost of $45,000. The dimensions of the addition will be 102 feet by 115 feet, and the improvements to be undertaken include the construction of an office, tool room, engine pits and drop pits.

A. R. A. Names Executive Committee

The secretary of the American Railway Association, J. E. Fairbanks, has announced the personnel of the executive committee for the calendar year 1921 as follows: Division I, Operating, General W. W. Atterbury; Division II, Transportation, E. J. Pearson; Division III, Traffic, C. H. Markham; Division IV, Engineering, H. G. Kelley; Division V, Mechanical, W. B. Storey; Division VI, Purchasing and Stores, W. G. Besler; Division VII, Freight Claims, N. D. Maher.

Safety Appliances for Cars of Special Construction

The Interstate Commerce Commission at a conference held on December 6 adopted the following ruling regarding the application of safety appliances on cars of special construction:

Cars of special construction, as contemplated by the commission's order of March 13, 1911, are cars which cannot be equipped with safety appliances as prescribed in the order for any specified classes enumerated therein. In the construction of new equipment which does not conform to the specified classes designated in the order, plans shall be submitted to the commission prior to construction of such cars for the purpose of determining the location and application thereto of all safety appliances required by statute and the order of the commission of March 13, 1911.

Research Graduate Assistantships at the University of Illinois

To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois maintains fourteen Research Graduate Assistantships in the Engineering Experiment Station. Two other such assistantships have been established under the patronage of the Illinois Gas Association. Each assistantship carries an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees. There will be thirteen vacancies in addition to two in gas engineering to be filled at the close of the current academic year. The positions are open to graduates of approved American and foreign universities and technical schools who are

prepared to undertake graduate study in engineering, physics, or applied chemistry. Nominations are made from applications received by the director of the Engineering Experiment Station each year not later than the first day of March and become effective the first day of the following September. Additional information may be obtained from the director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

MEETINGS AND CONVENTIONS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The spring meeting of the American Society of Mechanical Engineers will be held at the Congress Hotel, Chicago, May 23 to 26. Sessions are planned by the professional sections on aeronautics, fuel, management, material handling, machine shop, power, forest products and railroads, the details of which will be made public later.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Annual convention May 3 to 6 inclusive, Hotel Sherman, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next convention June 15-22, Atlantic City, N. J. Exhibit by Railway Supply Manufacturers' Association.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION VI—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio. Second annual meeting June 20-22, Atlantic City, N. J.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Spring meeting May 23 to 26 inclusive, Congress Hotel, Chicago.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CANADIAN RAILWAY CLUB.—W. A. Booth, 131 Charron St., Montreal, Que. Next meeting March 8. Paper on "The Repairing of Steel Freight Cars" will be presented by Samuel Lynn, M. C. B., Fittsburgh & Lake Erie Railway Company, together with stereopticon views.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 95 Liberty St., New York. Next meeting March 11. Paper on "Engine Terminal Layout" will be presented by H. E. Stitt, chief engineer, Austin Company, Cleveland.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Next meeting March 3 and 4, 1921, Hotel Sherman, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meeting second Tuesday of February, May, September and November, Hotel Sinton, Cincinnati, Ohio.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 715 Clarke Ave., Detroit, Mich. Next meeting August 16, 17 and 18, 1921, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago. Next annual meeting, May 24-26, 1921, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention, September 12, 13, 14 and 15, 1921, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention, May 23 to 26, 1921, inclusive, Planters' Hotel, St. Louis, Mo.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting March 8. Election of officers, together with annual entertainment.

NEW YORK RAILROAD CLUB.—H. D. Vought, 95 Liberty St., New York. Next meeting March 18. Paper on "Safety of Passengers in Steel Cars" will be presented by F. M. Brinckerhoff.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Fine St., San Francisco, Cal. Annual meeting Thursday, March 10, at 8 p. m. Election of officers.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in month except June, July and August, Americus Club House, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday in month except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Buffalo, N. Y.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Meeting third Monday each month except June, July and August.

PERSONAL MENTION

GENERAL

D. G. MCCORMICK has been appointed mechanical engineer of the Mobile & Ohio, with headquarters at St. Louis, Mo.

C. J. SEVIER has been appointed assistant to the superintendent maintenance of equipment of the Western Maryland, with headquarters at Hagerstown, Md.

O. C. CROMWELL has been appointed assistant to the chief of motive power and equipment of the Baltimore & Ohio, with headquarters at Baltimore, Md.

H. W. SALMON, JR., has been appointed acting fuel agent on the Missouri Pacific, with headquarters at St. Louis, Mo., succeeding W. P. Hawkins, who has resigned.

G. S. GOODWIN, corporate mechanical engineer of the Chicago, Rock Island & Pacific, has been appointed mechanical engineer of the Rock Island System, with headquarters at Chicago.

J. W. SASSER, superintendent of motive power of the Norfolk Southern, has resigned to become superintendent of motive power of the Virginian, with headquarters at Princeton, W. Va., succeeding R. E. Jackson, resigned.

J. C. GARDEN, superintendent of motive power on the Grand Trunk Railway at Stratford, Ont., has been appointed acting general superintendent of the motive power and car departments of the lines east of the Detroit and St. Clair rivers, and consulting engineer of the motive power and car departments of the Grand Trunk Western Lines, succeeding W. H. Sample, retired. John Roberts, general foreman, has been appointed acting superintendent of motive power, with headquarters at Stratford, succeeding Mr. Garden.

P. O. WOOD, superintendent of the St. Louis-San Francisco, with headquarters at Memphis, Tenn., has been appointed assistant superintendent of motive power with headquarters at Springfield, Mo. Mr. Wood was born at Memphis, Tenn., in 1877. He entered the service of the Kansas City, Memphis & Birmingham (now a part of the Frisco) in 1891 as a machinist apprentice in the Memphis shops. After completing his apprenticeship he served as a machinist and air brake repairman until 1904, when he became a locomotive fireman. In 1907 he was promoted to engineman and, in 1913, to assistant superintendent of locomotive performance. In 1916 another promotion made him assistant general superintendent of motive power. In 1917 he became division superintendent at Memphis and remained in that position until his recent appointment.

A. STURROCK, whose promotion to assistant superintendent of motive power on the Canadian Pacific, with headquarters at Winnipeg, Man., was announced in the February *Railway Mechanical Engineer,* was born on July 27, 1883, at Dundas, Ont. He entered railway service in 1901 as a machinist in the Stratford, Ont., shops of the Grand Trunk. After a year's service with the Grand Trunk, Mr. Sturrock came to the United States and was employed as a machinist, first on the Atchison, Topeka & Santa Fe, and later on the Denver & Rio Grande. His service with the Canadian Pacific began in July, 1904, when he was employed as a machinist in the company's shops at Winnipeg. He was promoted to locomotive foreman in 1911, with headquarters at Fort William, Ont., a position which he held until 1913, when he was transferred to Vancouver, B. C. In April, 1914, he was again promoted, being made general locomotive foreman of the shops of the Canadian Pacific at Ogden, Alta. A year and a half later Mr. Sturrock was made division master mechanic, with headquarters at Cranbrook, B. C., and in January, 1915, was promoted to general master mechanic of the Alberta district, with headquarters at Calgary, Alta. At the time of his recent promotion he was serving as general master mechanic of the British Columbia district at Vancouver.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

R. J. RHEAUME has been appointed assistant master mechanic of the Canadian National Railways Hornepayne, Ont.

Eugene Schull has been appointed master mechanic on the Frisco System, with headquarters at Sapulpa, Okla., succeeding C. F. Coffman, resigned.

C. E. McGann has been appointed master mechanic of the Pittsburgh division of the Baltimore & Ohio, with headquarters at Glenwood, Pa., succeeding W. C. Burel, resigned.

A. J. Flowers, assistant master mechanic on the Central of Georgia at Macon, Ga., has been appointed master mechanic, with headquarters at Columbus, Ga., succeeding E. G. Gross, resigned.

H. M. Allen, locomotive foreman on the Canadian Pacific, with headquarters at Alyth, Alta., has been promoted to master mechanic, on the Kenora Division, with headquarters at Kenora, Ont.

A. G. Fischer has been appointed master mechanic on the Frisco System at Memphis, Tenn., succeeding G. R. Wilcox, who has resigned. William Henry succeeds Mr. Fischer as assistant master mechanic at Monett, Mo.

A. Devine has been appointed assistant master mechanic of the Canadian National Railways at Campbellton, N. B., succeeding F. F. Carey, who has been appointed assistant master mechanic of the St. Maurice division, at Quebec, Canada.

J. E. Gould, master mechanic of the Charlotte Harbor & Northern, with headquarters at Arcadia, Fla., has been appointed master mechanic of the Cumberland & Manchester, with headquarters at Barbourville, Ky. F. S. Market has succeeded Mr. Gould at Arcadia.

W. J. Denix, master mechanic on the Canadian Pacific at Moose Jaw, Sask., has been appointed master mechanic at Vancouver, B. C., succeeding A. Sturrock, who has been promoted to assistant superintendent of motive power at Winnipeg, Man.

J. Gibson, locomotive foreman on the Canadian Pacific, with headquarters at Sutherland, Sask., has been promoted to master mechanic, with headquarters at Moose Jaw, Sask., succeeding A. Peers, whose appointment as master mechanic was announced in the February issue.

G. W. Ray, master mechanic on the Western division of the Chicago & Alton, with headquarters at Slater, Mo., has been transferred to the Northern and Southern divisions, with headquarters at Bloomington, Ill., succeeding M. J. McGraw, who has resigned. F. Stone succeeds Mr. Ray.

H. A. Amy, locomotive foreman on the Canadian Pacific, with headquarters at North Bay, Ont., has been promoted to division master mechanic, with headquarters at Ottawa, Ont. E. G. Freeman, locomotive foreman, with headquarters at Cartier, Ont., has been transferred, succeeding Mr. Amy.

W. D. Hartley, whose appointment as master mechanic on the Atchison, Topeka & Santa Fe at Clovis, N. M., was announced in the February issue of the *Railway Mechanical Engineer,* was born on August 14, 1886, at Albuquerque, N. M. He was graduated from the high school at Las Vegas, N. M., in 1903, and in May of the same year entered the employ of the Atchison, Topeka & Santa Fe, serving as a machinist apprentice and machinist until September, 1909, when he became roundhouse foreman at Richmond, Cal. From October, 1914, to February, 1918, he was division foreman at Barstow, Cal., and from February, 1918, until his recent transfer as master mechanic, was general foreman at Richmond.

CAR DEPARTMENT

O. J. Greenwell has been appointed master car repairer on the Tuscon division of the Southern Pacific, with headquarters at Tucson, Ariz., succeeding A. G. Saunders, who has resigned.

A. J. Krueger, shop inspector of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, has been promoted to master car builder, with the same headquarters, succeeding R. W. Miller, deceased.

SHOP AND ENGINEHOUSE

W. T. Abington has been appointed night roundhouse foreman on the Rock Island at Herington, Kan., succeeding S. L. Hamilton, resigned.

SUPPLY TRADE NOTES

L. A. Lenhart, plant manager of the General American Tank Car Corporation, East Chicago, Ind., has resigned to become vice-president of the Youngstown Steel Car Company, Niles, Ohio.

The Atlas Valve Company, Newark, N. J., has secured the sole patents and rights to manufacture the Ideal automatic pump governor, by purchase from the Ideal Automatic Manufacturing Company, New York.

E. R. Lewis, editor of the Maintenance of Way Cyclopedia, one of the publications of the Simmons-Boardman Publishing Company, has been appointed officer engineer of the Michigan Central with headquarters at Detroit, Mich.

John L. Bacon has been appointed manager of the service and inspection department of the Franklin Railway Supply Company, with headquarters in New York. Mr. Bacon was formerly district manager of the Cleveland office of the same company.

The Black & Decker Manufacturing Company, Baltimore, Md., has opened a new branch office and service station at 75 Fremont street, San Francisco, Cal. This office has jurisdiction of the company's affairs over the entire Pacific coast territory and is in charge of F. A. Johnson.

B. A. Bell, railway specialist for the Western Electric Company, has been appointed railway representative of this company at Atlanta, Ga., succeeding J. W. Smith. Before taking up the duties of railway specialist Mr. Bell was general salesman for the Western Electric Company.

Theodore L. Dodd has been elected vice-president and a member of the board of directors of the Allegheny Steel & Tube Company, with headquarters at Chicago. Mr. Dodd will have jurisdiction over the sales in the Middle West, extending to the Pacific coast.

The Chicago Flexible Shaft Company opened an office at Detroit on February 1 for the sale and distribution of Stewart furnaces and to extend direct service in heat treating problems to customers in that territory. The new office is located at 601 Kerr building, and is in charge of George P. Beck.

A. T. Kuehner has been appointed mechanical engineer of the Standard Stoker Company, Inc., New York. Mr. Kuehner is the inventor of the Keener journal box for locomotive drivers and trucks. This device will be manufactured and placed on the market by the Standard Stoker Company. Mr. Kuehner, until his recent appointment, was on the staff of C. A. Gill, superintendent of motive power of the Baltimore & Ohio.

Max Grant, who has been associated with the Tropical Paint & Oil Company, Cleveland, Ohio, has been appointed manager of technical railway sales, of the Glidden Company, Cleveland, and M. F. Emrich, formerly vice-president and general manager of the Campbell Paint & Varnish Company, St. Louis, a subsidiary of the Glidden Company, has been appointed general sales manager of the industrial division of the Glidden Company, with headquarters at Cleveland.

Alba B. Johnson, formerly president of the Baldwin Locomotive Works, has resigned from the board of that company and also as a director of the Standard Steel Works, Philadelphia, Pa. John M. Hansen, president of the Standard Steel Car Company, Pittsburgh, has been elected a director and member of the executive committee of the Baldwin Locomotive Works and W. L. Austin, vice-chairman of the board of directors of the Baldwin Locomotive Works, has been elected a director of the Standard Steel Works, Philadelphia, to succeed Mr. Johnson.

Louis B. Rhodes, southeastern sales representative of the Vapor Car Heating Company, Inc., with headquarters at Richmond, Va., died of heart failure on January 25, at Nashville, Tenn. Mr. Rhodes was formerly master mechanic on the Georgia Southern

& Florida and had served as superintendent of motive power of the Virginian. Later he was with the Ward Equipment Company. He was in the service of the Standard Heat & Ventilation Company at the time when the latter company was consolidated with the Chicago Car Heating Company in the organization of the Vapor Car Heating Company.

The Brown & Sharpe Manufacturing Company has recently prepared a list of graduate apprentices who have completed the company's training courses during the seventy or more years that the apprenticeship system has been in use in the plant. In the Brown & Sharpe organization, the executives, with few exceptions, were formerly Brown & Sharpe apprentices. This list, though incomplete, contains the names of many now holding important positions and serves to prove that the apprenticeship course lays the foundation on which to build broadly and progressively. The company is sending these booklets to any former Brown & Sharpe graduate apprentice or to others who are interested in training courses and desires to add as many names as possible to the next edition.

The executive, sales, purchasing and accounting departments of the Reed-Prentice Company, the Becker Milling Machine Company and the Whitcomb-Blaisdell Machine Tool Company, 53 Franklin street, Boston, will be located on and after February 21 at the Reed-Prentice plant, 677 Cambridge street, Worcester, Mass. On account of present business conditions, the Becker plant at Hyde Park, Boston, is operating with reduced force, production to be increased as soon as conditions warrant. The Becker cutter department business showed a marked increase in volume during January and it is expected to be running full capacity shortly. The Worcester plants of the Reed-Prentice and Whitcomb-Blaisdell Machine Tool Company are completing orders on hand, and are also building machines to be placed in stock.

The Toledo Crane Company, Bucyrus, Ohio, successors to The Toledo Bridge & Crane Company, Toledo, builders of Toledo cranes, has been chartered under the laws of Ohio, with the following officers: C. F. Michael, president; W. F. Billingsley, vice-president and general manager; A. G. Stoltz, treasurer, and C. Gallinger, secretary. The officers with C. H. Dexheimer are the stockholders and directors. All stock has been subscribed and paid in and none will be offered for public subscription. The main office is at Bucyrus with sales offices in New York City, Boston, Philadelphia, Pittsburgh, Buffalo, Cleveland, Cincinnati, Chicago, St. Louis, Kansas City, Seattle, Salt Lake City, San Francisco, Birmingham and Minneapolis. The company will have completed by March 15 a building 120 ft. by 320 ft., to be used for erecting and assembly, with a machine shop 60 ft. by 300 ft., a structural shop 90 ft. by 300 ft., a pattern shop 60 ft. by 140 ft., and a forge shop 40 ft. by 100 ft., all to be equipped with modern tools.

Clifford J. Ellis, district manager of sales for the Midvale Steel & Ordnance Company and the Cambria Steel Company, with headquarters at Chicago, Ill., died at his home in Evanston, Ill., on January 31. Mr. Ellis had been district manager of sales for more than 30 years and for 37 years had been in the service of the Cambria Steel Company at Chicago. He was born on November 25, 1860, and when 19 years of age entered the employ of Wood Morrell & Co., Johnstown, Pa., who controlled the Cambria Iron Company. Not long thereafter he became assistant to the treasurer and in 1883 he was transferred to Chicago, entering the sales department of the company, where he had served up to the time of his death.

C. J. Ellis

Harry M. Evans, eastern sales manager of the Franklin Railway Supply Company, Inc., has been elected vice-president of the company, with offices at 30 Church street, New York. Mr. Evans was born at Meadville, Pa., and was educated in the public schools at that place. He began railroad work as a call boy on the Erie, and served in various positions in the mechanical, transportation and traffic departments of that road. He entered the mechanical department of the Franklin Railway Supply Company in October, 1908, as traveling representative. In August, 1916, he became assistant western sales manager, and in January, 1917, was appointed eastern sales manager, which position he was holding at the time of his recent election.


Harry M. Evans

E. Emery, formerly manager of the R. H. Blackall Company, Pittsburgh, Pa., has opened offices in the Oliver building, Pittsburgh, under the firm name of the Emery Sales Company, handling railway supplies. Mr. Emery will serve as special representative, reporting to the Pittsburgh office of the Schaefer Equipment Company, handling its full line of foundation brake details in a defined territory. He will also have charge of sales in the Pittsburgh district of the Mason Packing Company, Pittsburgh, which manufactures the Mason semi-metallic packing for locomotive air pumps, and will represent the Standard Horsenail Company, New Brighton, Pa., handling its line of taper pins, shaft keys and channel pins. Mr. Emery was graduated from the Chicago Manual Training School in 1899, after which he was connected for two years with the F. B. Reddington Company, Chicago, in an engineering capacity. He was for eight years with A. Sorge, Jr., & Company, Chicago, handling a steam specialty line. He was engaged in sales and engineering work for a time and later was with the Parker Boiler Company, Philadelphia, Pa., for one year as general sales manager. Mr. Emery was then assistant sales manager of the Rust Boiler Company, Pittsburgh, and when that business was sold to other interests he joined the R. H. Blackall Company.


E. Emery

Locomotive Superheater Company Takes Over Locomotive Feed Water Heater

The Locomotive Superheater Company, New York, has acquired the patents and business of the Locomotive Feed Water Heater Company, also of New York. Feed water heating and superheating have many factors in common, and logically the former can best be perfected by a combined organization broadly experienced and trained in this field. During the past few years remarkable progress has been made in successfully adapting feed water heaters to locomotives, and if the thermal efficiency of the locomotive is to be further increased, the development of the feed water heater should be conducted with a full knowledge of the engineering features of the superheater.

The Locomotive Superheater Company will conduct the further application of the apparatus for preheating feed water through its regular engineering, inspection and service organizations, to which has been added the operating organization of the Locomotive Feed Water Heater Company. This consolidation of resources and effort promises more intensified development and better service to the railroads.

Westinghouse Air Brake Company

S. W. Dudley, chief engineer of the Westinghouse Air Brake Company, Wilmerding, Pa., retired on February 1 to accept a professorship of mechanical engineering at Yale University.

Mr. Dudley, who is a graduate of Yale University, had been associated with the air brake company for 17 years. He spent the summers of the years 1903 and 1904 in the plant as a special apprentice, returning to school to complete a post graduate course during the other seasons. In 1905, he established permanent connections with the Westinghouse Air Brake Company and assisted in and compiled much of the data pertaining to the tests of the Type R triple valve on the Pennsylvania, and the ET equipment and the Type R passenger triple valve on the New York Central. In 1906 he was assigned to the New York office to follow the installation, operation and maintenance of new air brake equipment that was placed in service on electric locomotives and motor cars during the inauguration of the New York Central's terminal electrification and, in 1907, returned to Wilmerding to take charge of the air brake publicity department. From 1909 until his appointment as chief engineer in 1914, he served as assistant mechanical engineer and assistant chief engineer (in charge of operation).


S. W. Dudley

Alexander England, who has been appointed chief engineer to succeed Mr. Dudley, has been a member of the air brake organization for the past 22 years and, since 1914, has served as assistant chief engineer. He was born in Dundee, Scotland, and at an early age entered the employ of the Scotch firm of Pierce Brothers, engineers and shipbuilders, to serve an apprenticeship and finished a course of study that earned him a diploma in mechanical engineering from the City and Guilds of London Technical Institute, he entered the service of the Mercantile Steamship Company of London as an engineer in the Mediterranean and Black Sea trade. In 1887 he left the marine service and went to Pittsburgh, Pa., where he took a position as assistant superintendent of the firm of Thomas Carlin's Sons, manufacturers of hoisting engines, brick plant machinery, etc. Later he served in various capacities with the Specialty Manufacturing Company, Allegheny; the Jones & Laughlin Steel Company, Pittsburgh, and in 1898, became associated with the Westinghouse Air Brake Company to do practical work under the chief engineer. In 1905, he was made chief draftsman, and in 1914 was appointed assistant chief engineer.


A. England

TRADE PUBLICATIONS

HAND AND MACHINE TOOLS.—The McCrosky Tool Corporation, Meadville, Pa., has issued a 64-page illustrated catalogue descriptive of their various types of tools, such as reamers, chucks, lathes, milling machines, etc. The catalogue is divided into several sections, each section being devoted to a detailed description of a particular tool. Prices and specifications are also given.

LOCOMOTIVE CRANES.—A catalogue of detailed parts of Brownhoist locomotive cranes has recently been issued by the Brown Hoisting Machinery Company, Cleveland, Ohio. All the parts are shown in photographs in which each detail is clearly numbered to facilitate identification for ordering. The book also contains illustrated directions for erecting and operating these locomotive cranes.

BELTING.—"A Saving for Every User of Belting" is the title of a new and interesting catalogue published by the Stanley Belting Corporation, Chicago, Ill. Aside from the general features of a well-worked out descriptive book, it gives valuable instructive points and considerations for every user of belting. The results of a test of Stanley belting are given and several typical installations are shown.

WROUGHT IRON AND STEEL.—The Reading Iron Company, Reading, Pa., has issued Bulletin No. 2 in which the structural differences between wrought iron and steel and their relation to the field of welded pipe have been described in a simple way. Photomicrographs of wrought iron and steel are shown and the structure of the two materials is discussed in a manner that is of interest to the layman as well as the engineer.

GATE, GLOBE, ANGLE, AND CHECK VALVES.—The Walworth Manufacturing Company, Boston, Mass., has issued a six-page folder which illustrates the diversified line of brass valves which this company manufactures. A list is included showing the sizes in which the various types are manufactured and giving a list of prices. The circular calls attention to the fact that the Walworth Manufacturing Company has been making valves since 1842.

RADIAL FLOW HEATER.—Catalogue F, issued recently by the Ross Heater & Manufacturing Company, Inc., Buffalo, N. Y., contains 39 pages devoted to the description and illustration of the two general types of Ross heaters. One of these types is the radial flow instantaneous heater, in which the liquid is heated as it is used. The other type is the storage heater, which, as the name implies, has a storage capacity to be drawn on in emergency. Several examples of each type of heater are given.

INJECTORS.—The new 1920 catalogue, issued by William Sellers & Co., Inc., Philadelphia, Pa., is a well arranged and fully illustrated book. It is divided into six sections, the first section being devoted to a description of the various classes of injectors. Main check and stop valves are described in section two; steam valves, in section three, and locomotive feed water strainers, ejectors, etc., in section four. A table and diagrams of tests are given in section five. Hints for the maintenance and repair of injectors are also included.

TRANSVEYORS.—A new edition of the Transveyor Picture Book has been issued recently by the Cowan Truck Company, Holyoke, Mass. This presents in an attractive book form the advantages and many possible uses of the Cowan transveyor. The photographs were taken at random from a great variety of industries and tell a forceful story without many words. Present models and specifications of the Cowan transveyor are given, and a two-page diagrammatic chart showing structural features and advantages is included.

PERFORMANCE OF STEAM BOILER PLANTS.—Brownlie & Green, Ltd., Manchester, England, have recently reprinted an article by David Brownlie entitled "Exact Data on the Performance of Steam Boiler Plants, Average Figures for the Performance of Some Different Types of Steam Boilers." The author points out that the figures usually taken in practice are entirely erroneous and presents data obtained as a result of investigations during ten years on nearly 500 boiler plants, giving the average figures for different types of boilers.